



Enabling Grids for E-scienceE

www.eu-egee.org/uf2



Enabling Grids for E-scienceE

EGEE USER FORUM

9 - 11 MAY 2007 MANCHESTER (UK)

The EGEE Production Grid



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IT Department, CERN

www.eu-egee.org

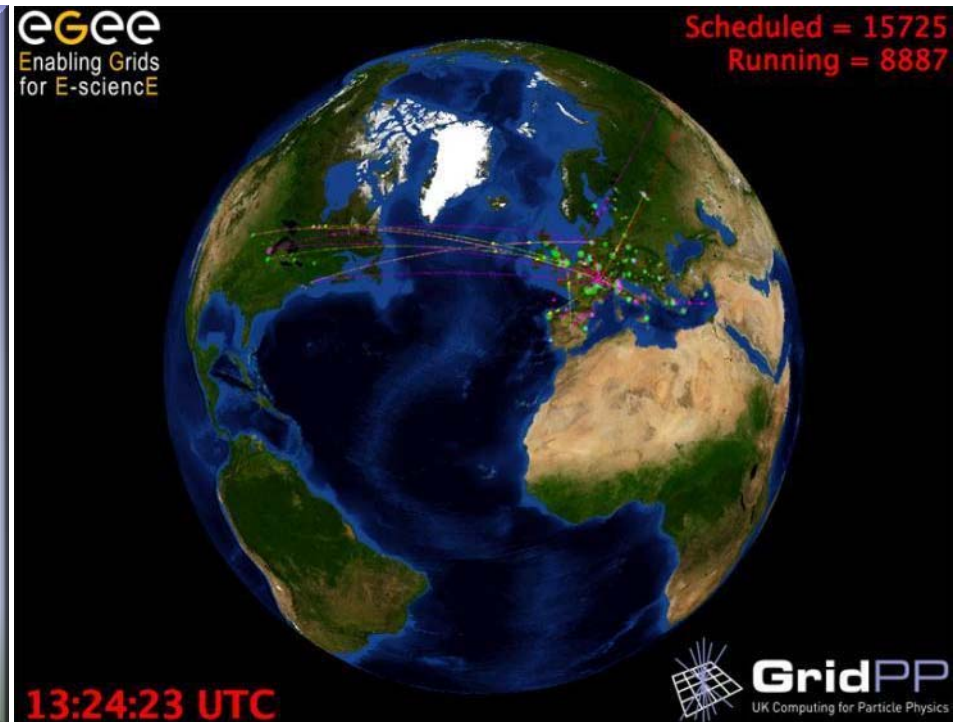




- Flagship grid infrastructure project co-funded by the European Commission
- Now in 2nd phase with 91 partners in 32 countries

Objectives

- Large-scale, production-quality grid infrastructure for e-Science
- Attracting new resources and users from industry as well as science
- Maintain and further improve gLite Grid middleware

EGEE
Enabling Grids
for E-science

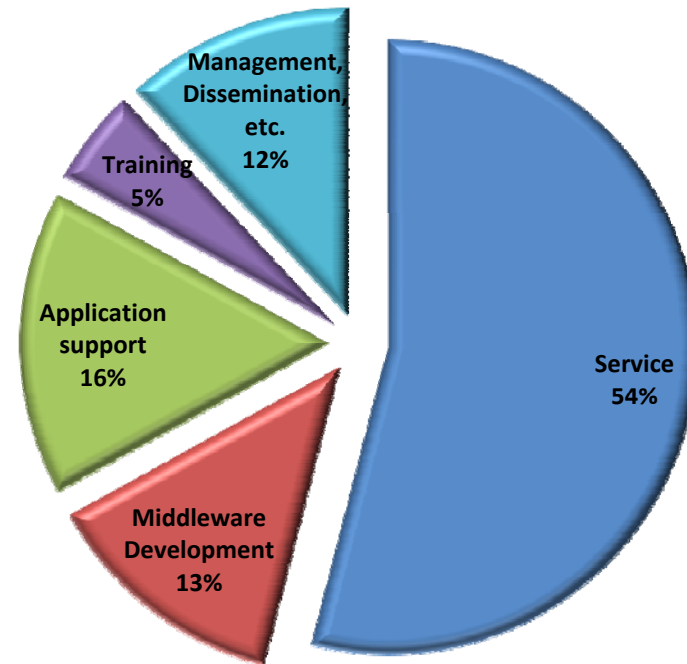
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Running = 8887

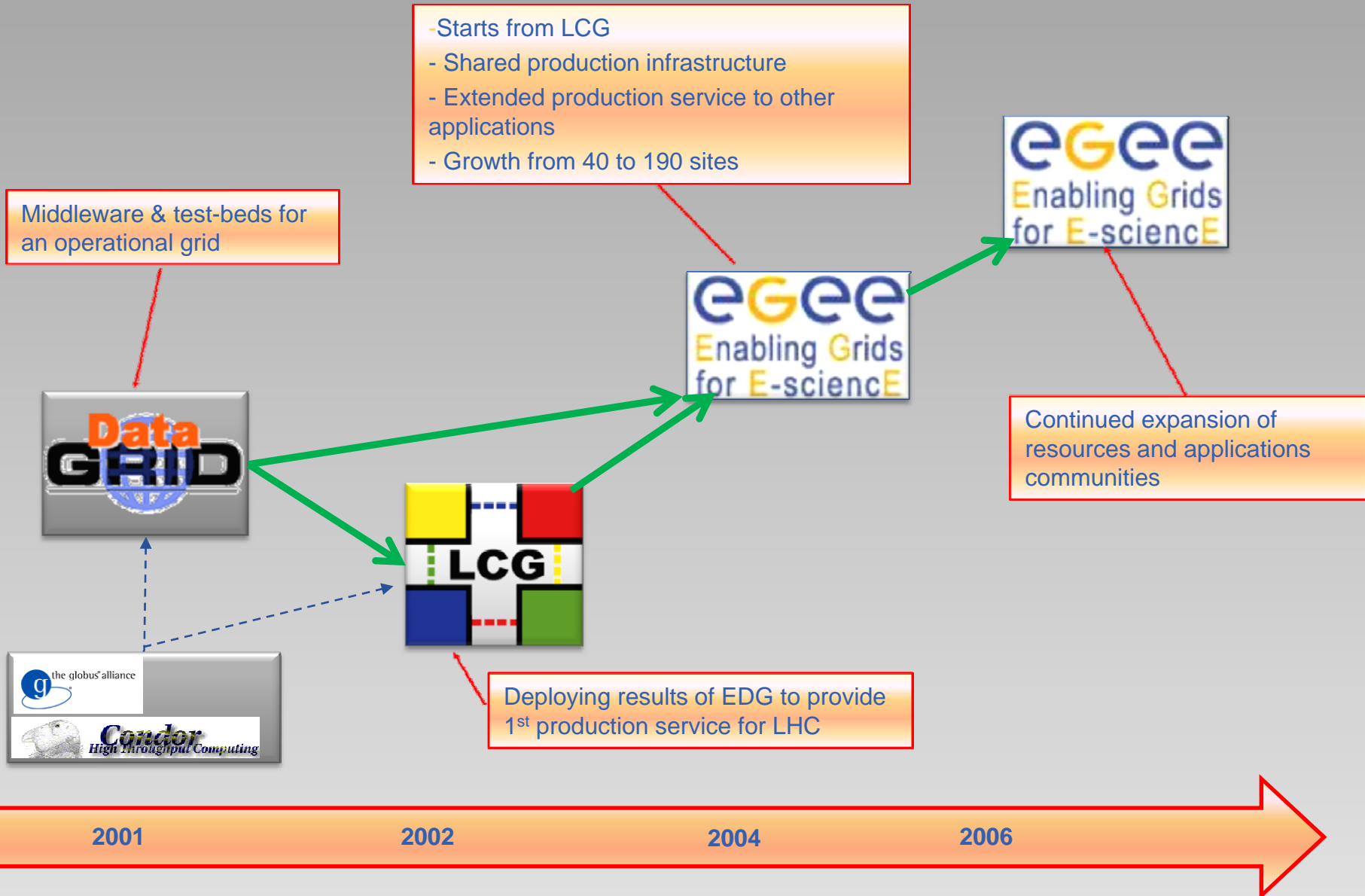
13:24:23 UTC

GridPP
UK Computing for Particle Physics

- **EGEE infrastructure & services**
 - How we got to this point
 - Overview of services
 - Status
 - Middleware
 - Training etc.
- **Applications**
 - Some key successes
- **Interoperation/interoperability**
 - ... and related projects
- **EGEE and standards ...**
- **Open issues**
- **What next?**

EGEE Project Activities

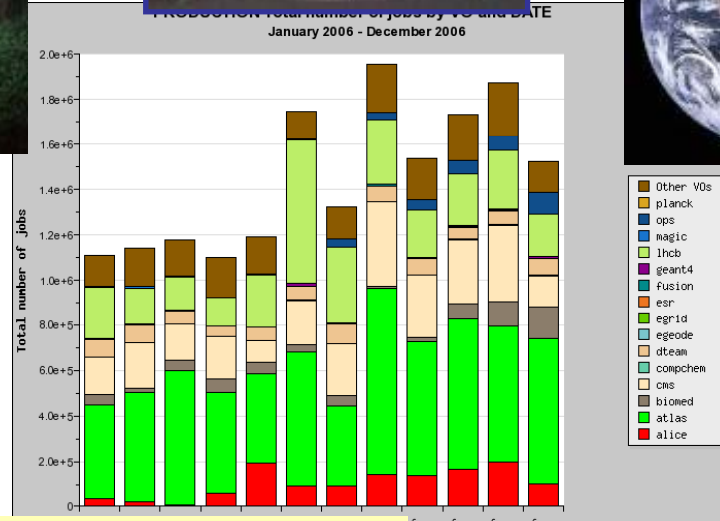
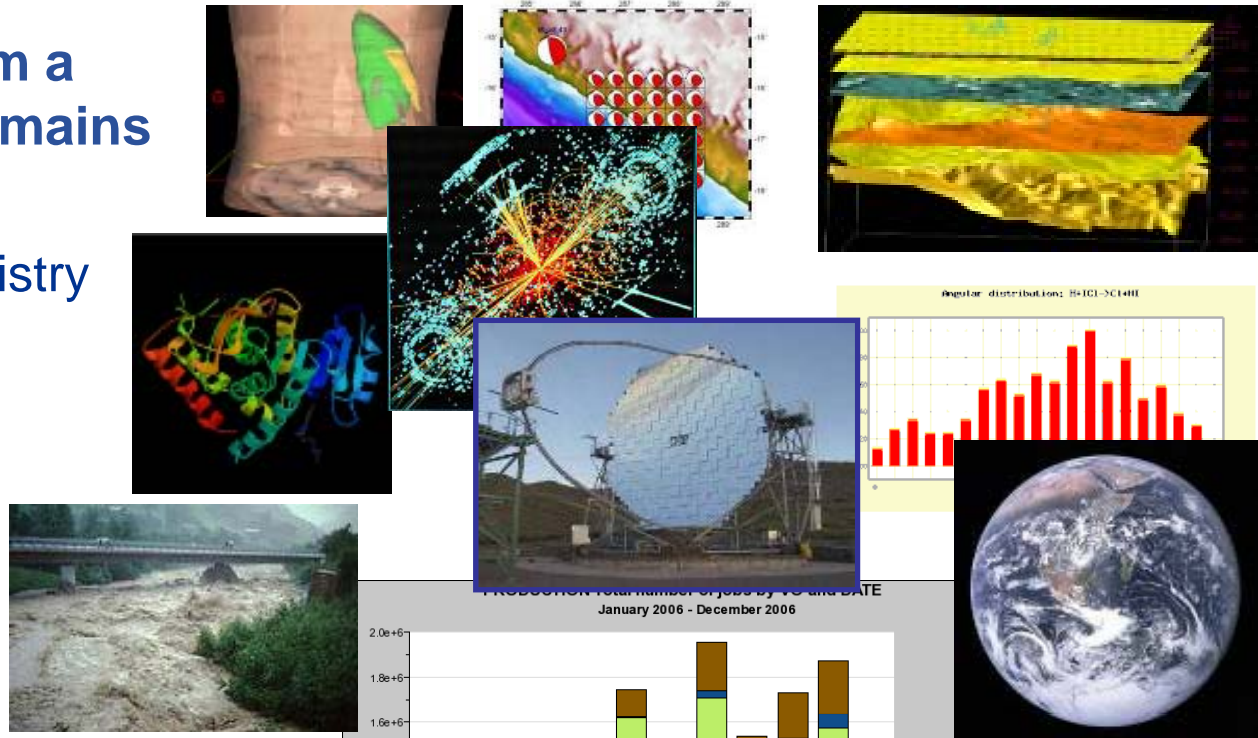




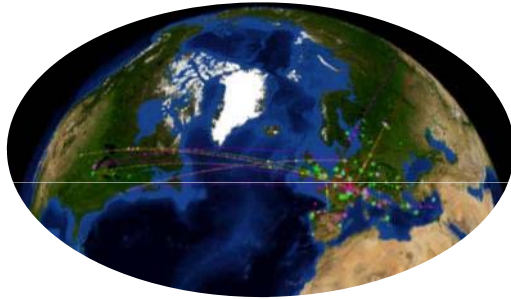
- Many applications from a growing number of domains

- Astrophysics
- Computational Chemistry
- Earth Sciences
- Financial Simulation
- Fusion
- Geophysics
- High Energy Physics
- Life Sciences
- Multimedia
- Material Sciences
- ...

~ 200 Virtual Organisations



Applications list: <https://edms.cern.ch/file/722132/3/EGEE-II-DNA4.2.1-722132-v2.5-1.pdf>



Test-beds & Services

Production Service

Pre-production service

Certification test-beds

Training infrastructure

Support Structures & Processes

Operations Coordination Centre

Regional Operations Centres

Global Grid User Support

EGEE Network Operations Centre

Operational Security Coordination Team

Training activities

Security & Policy Groups

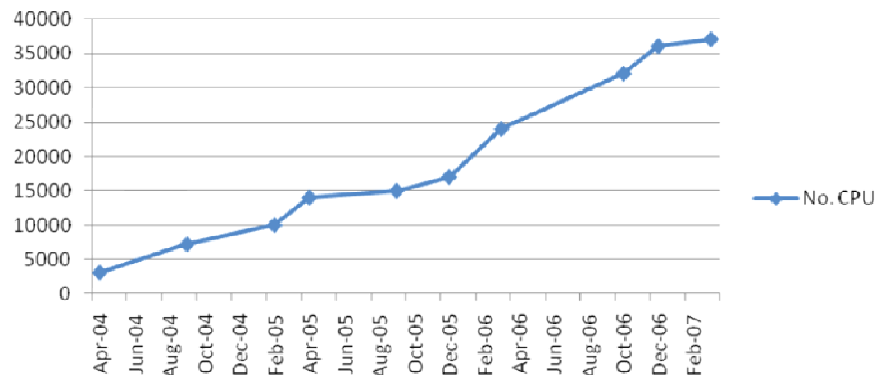
Joint Security Policy Group

EuGridPMA (& IGTF)

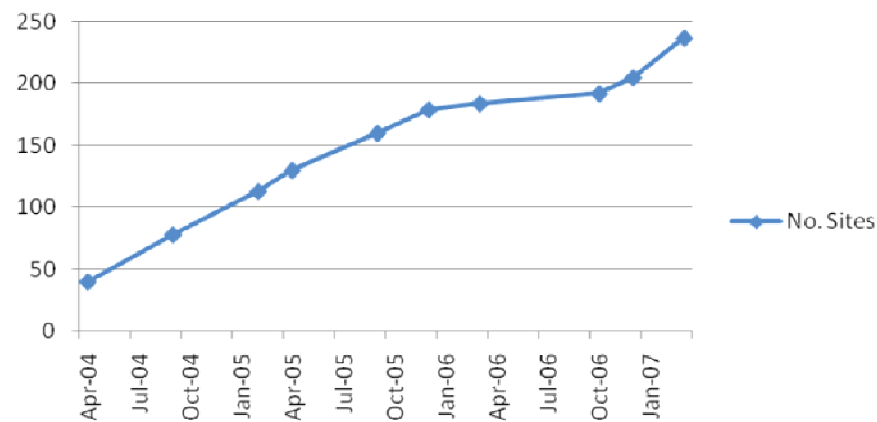
Grid Security Vulnerability Group

Operations Advisory Group

No. CPU

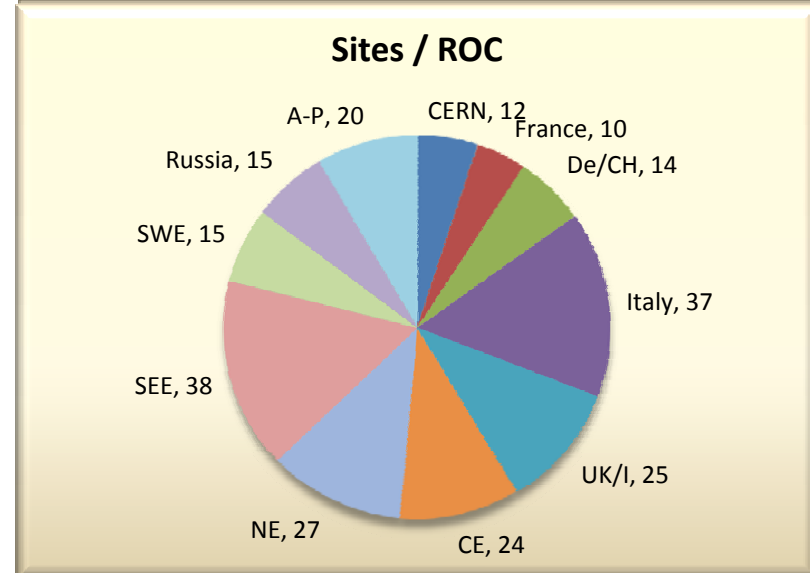
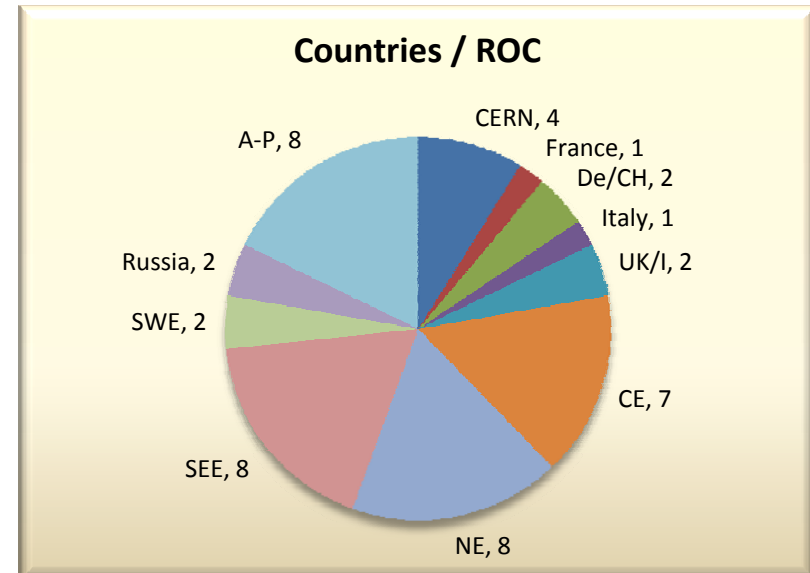
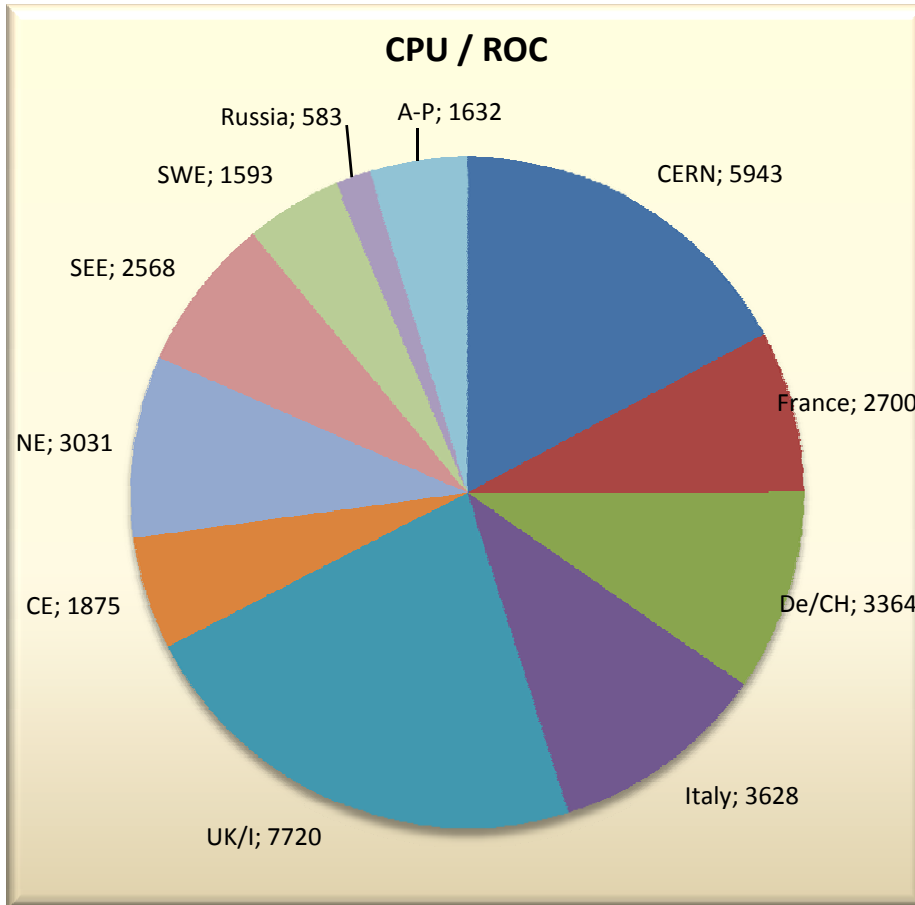


No. Sites

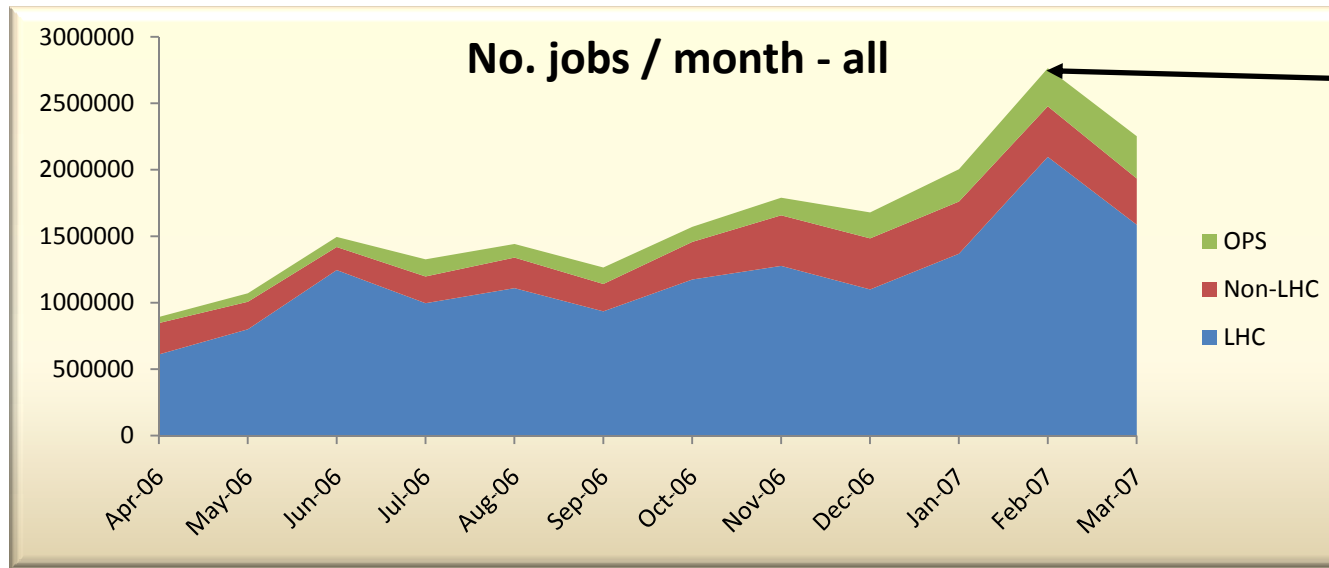


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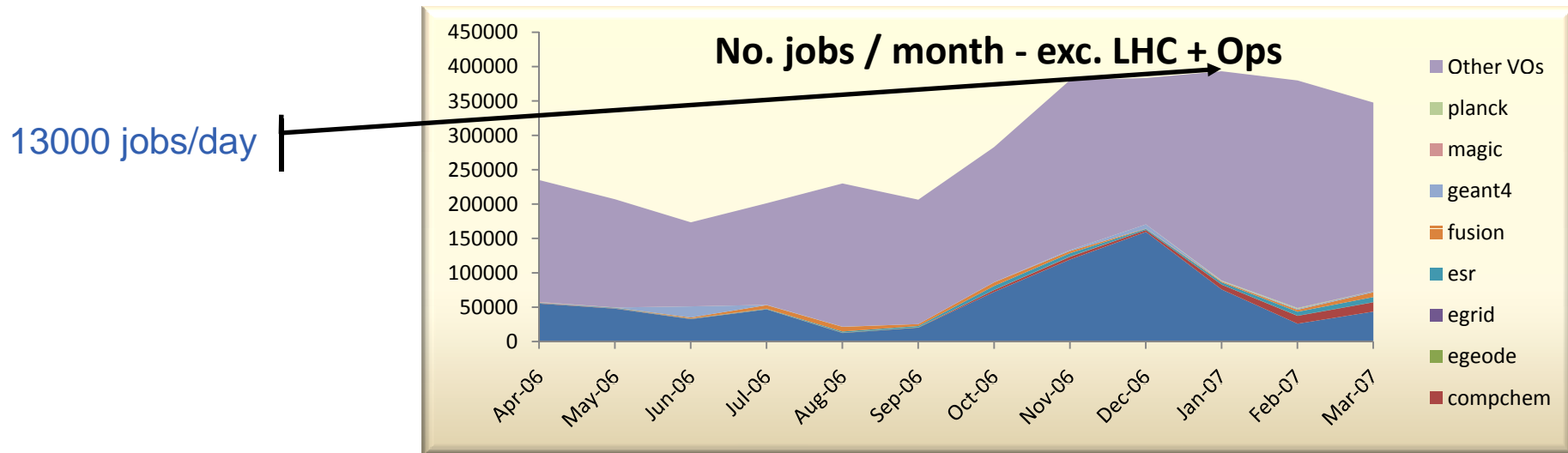




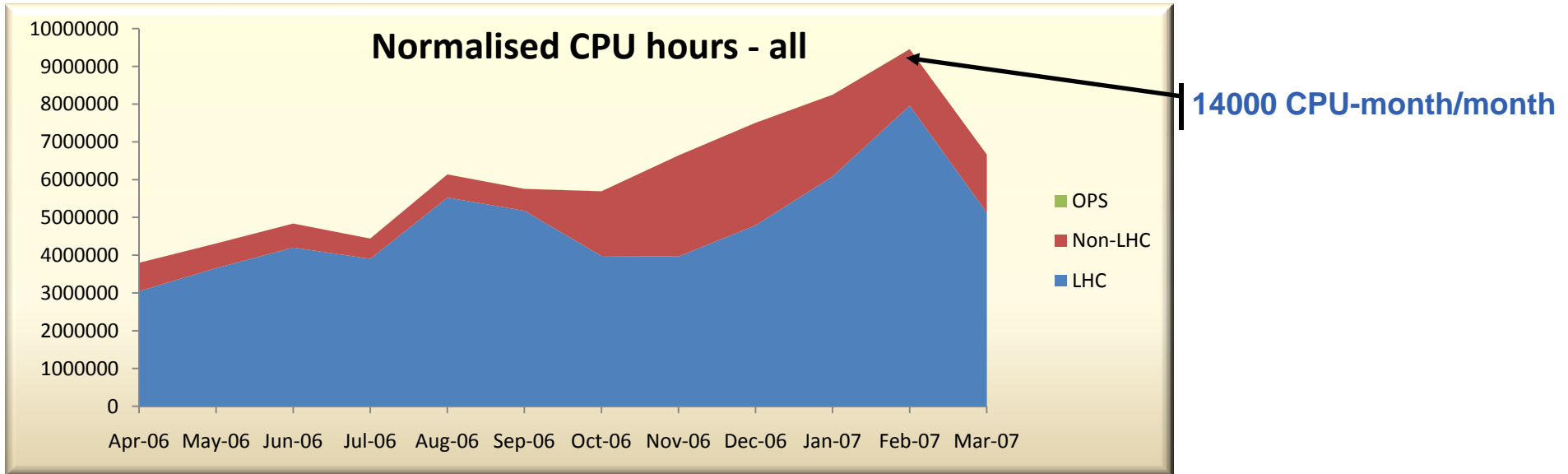
- ▶ 35000 CPU
- ▶ 45 countries (31 partner countries)
- ▶ 237 sites (131 partner sites)



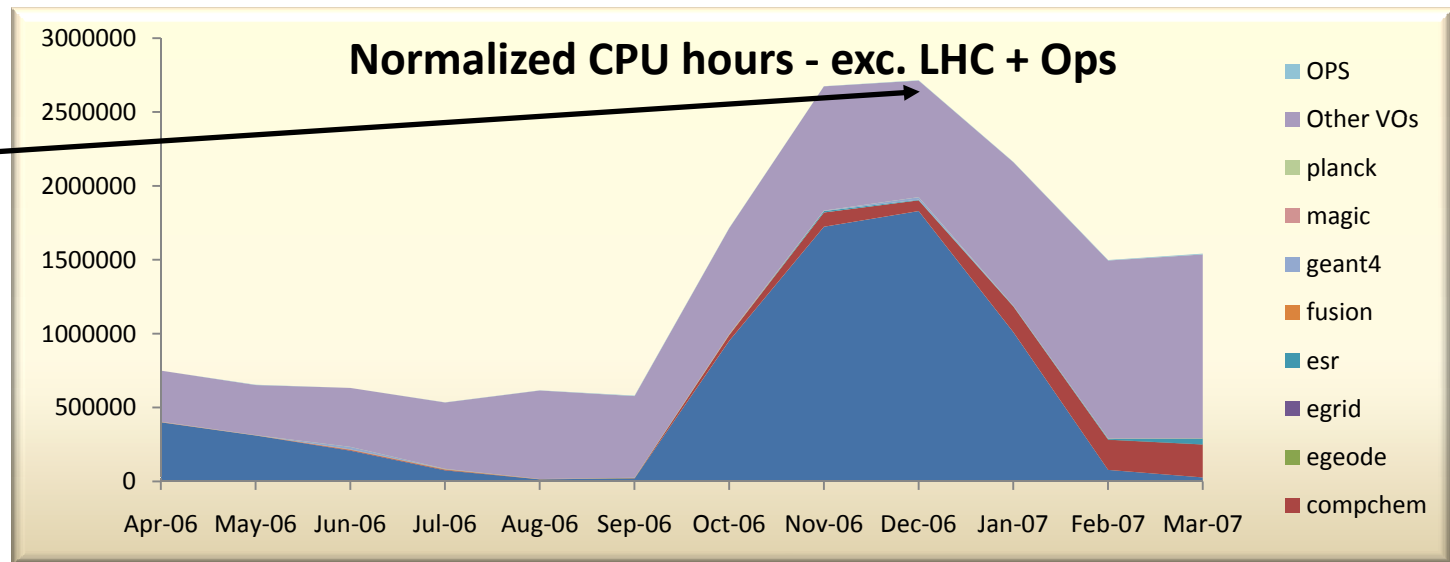
98000 jobs/day

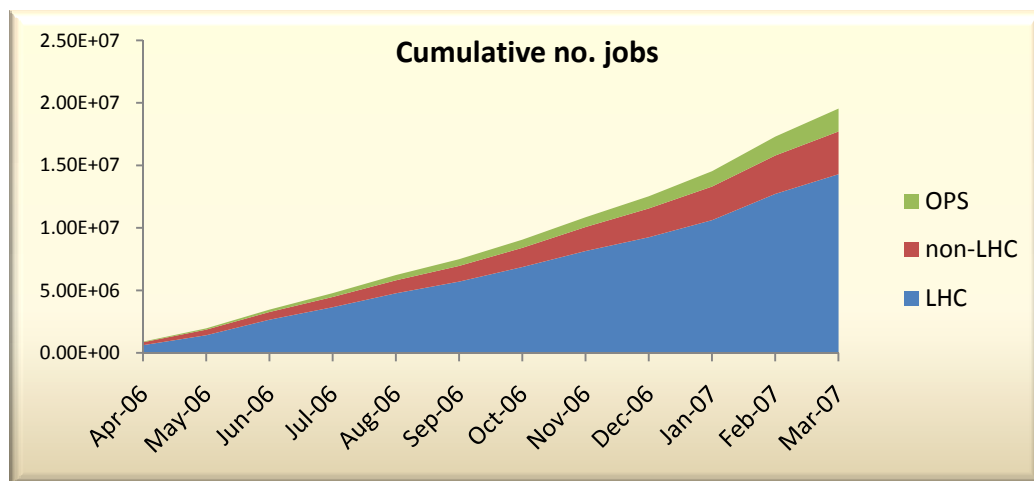


13000 jobs/day



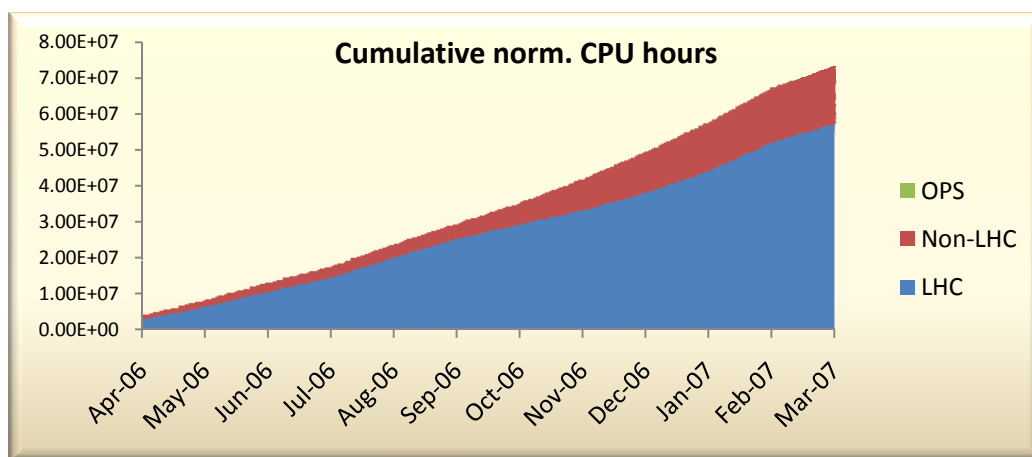
3600 CPU-month
~ 1/3 of total





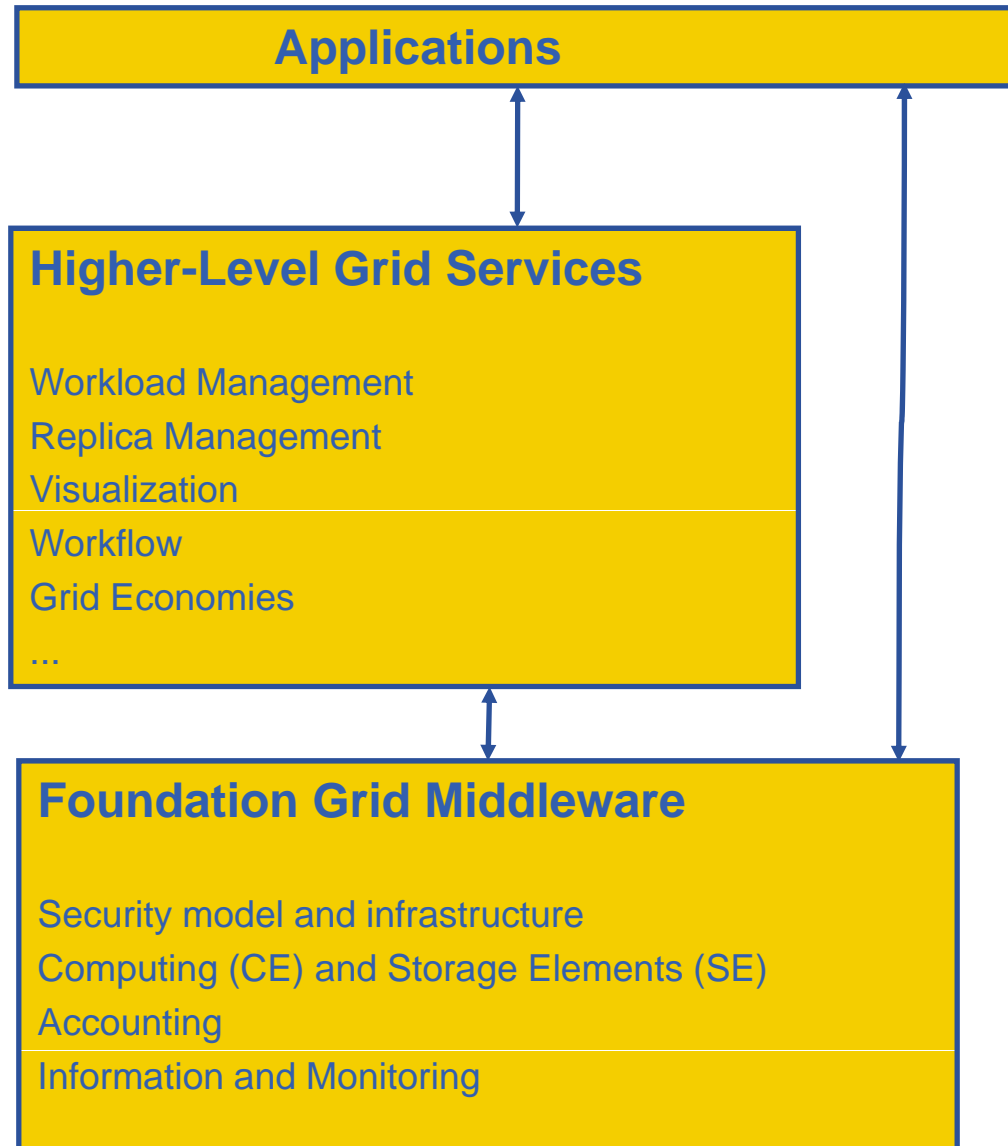
- **19.6 million jobs run in 1st year of EGEE-II**

- 56000 per day sustained average
- Peak of 98000
- Non-LHC 13500 /day
 - Level of total in EGEE in 2005



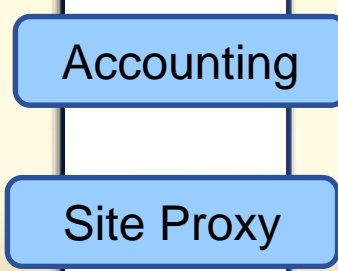
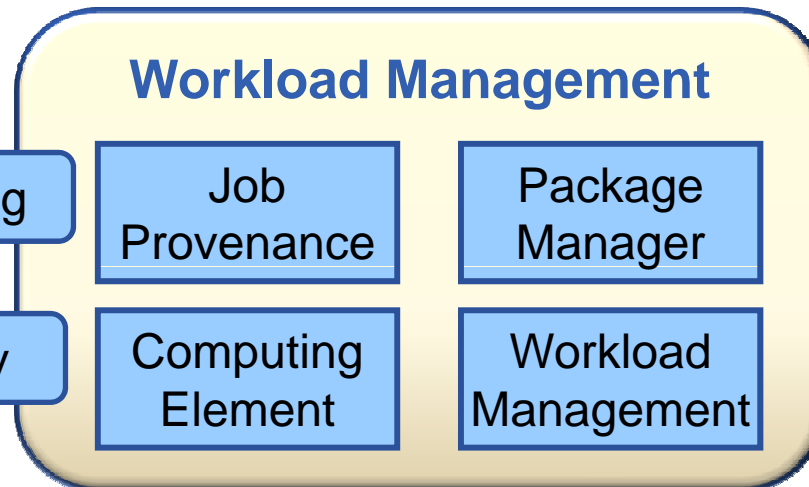
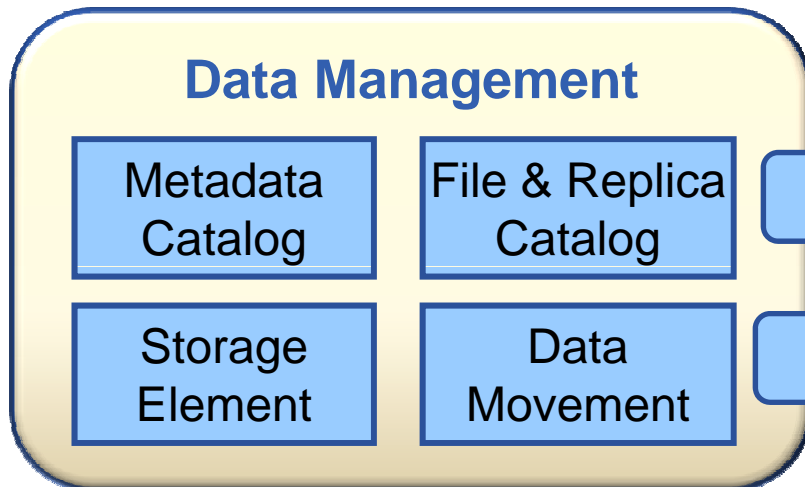
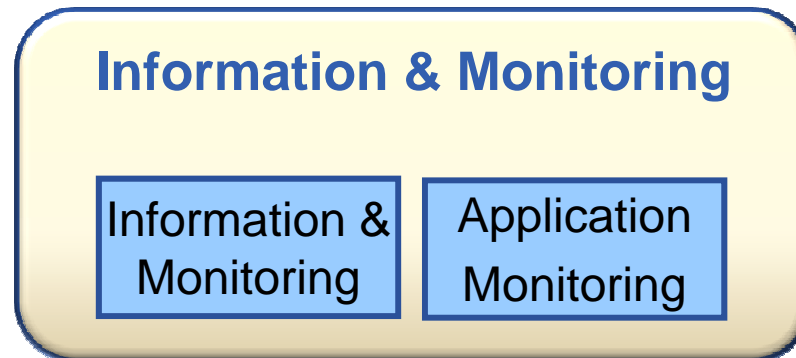
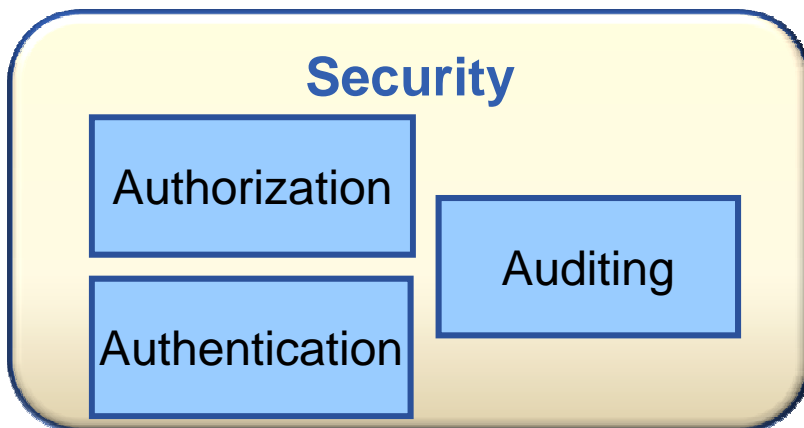
- **8400 CPU-years delivered in 1 year**

- ~1/3 of total available sustained over the year
- Peak of 50% of available in Feb '07
- ~1/3 of total was non-LHC in Dec '06



- **Higher-Level Grid Services**
 - Additional functionality

- **Foundation Grid Middleware**
 - Robustness
 - Coexistence
 - Interoperability

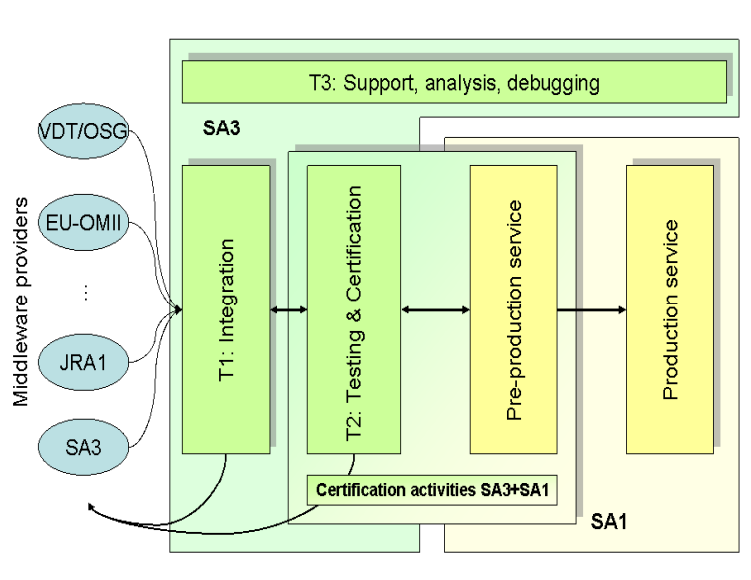


Overview paper <http://doc.cern.ch/archive/electronic/egge/tr/egge-tr-2006-001.pdf>

- The goal is to produce a *middleware distribution* that can be deployed widely
- Certification testing:
 - Installation and configuration
 - Component (service) functionality
 - System testing (trying to emulate real workloads and stress testing)

Test-beds

- Virtual test-beds for individual testers (~5)
- Dynamically allocated test nodes (> 50 nodes)
- Central certification test-bed
- Distributed test-beds for specific functions



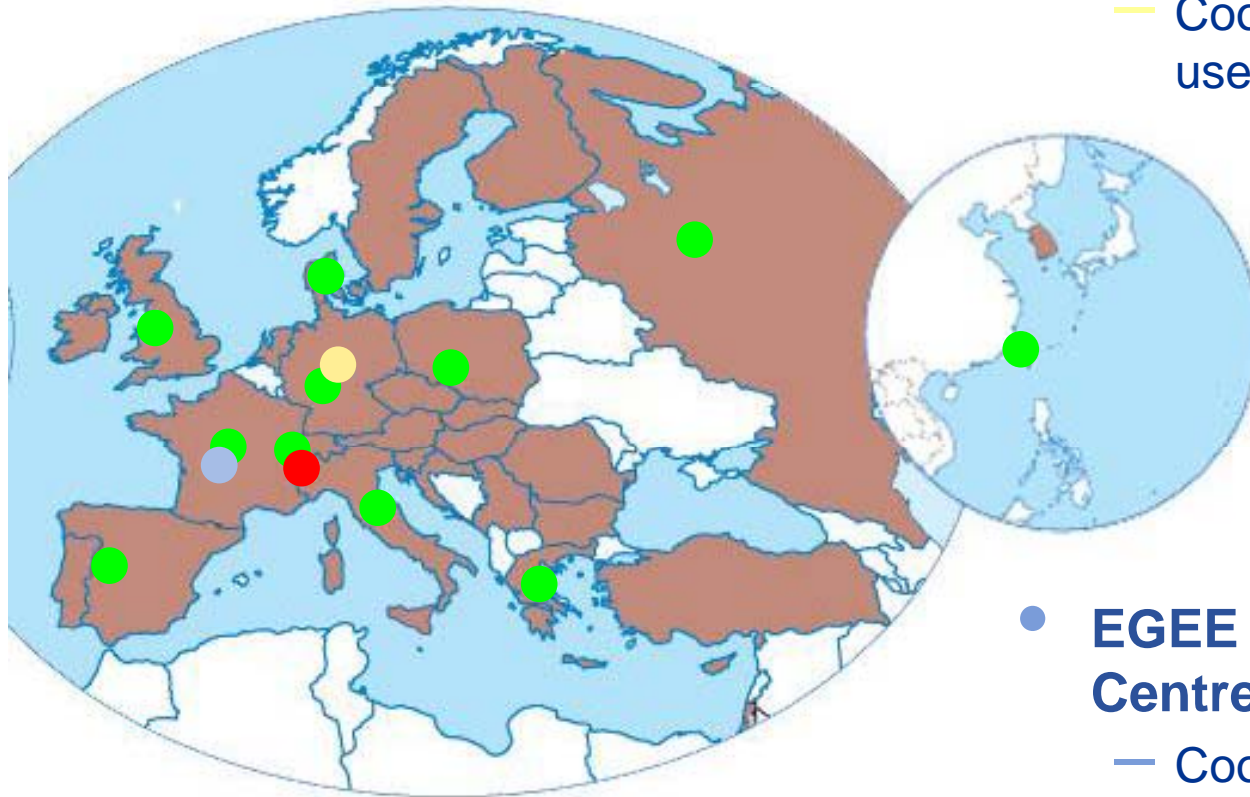
	a	b	c	d	e	f	g	h	i	j	k	l
0		2039 EDII_top Configured	2020 PX Configured	1B	1xb2017 EDII_top Configured	2	3+s14	1730 VOBCX Configured		Stable	Config	1774 VOBCX Configured
1				2032 MS Configured		0744 MS Configured	6122 MS OS	1928 VMS Configured				1912 MS Configured
2	2057 UIcomb Configured			1765 UIcomb Configured			6119 UI Configured	0714 SAM Configured		1917 UI Configured		1778 UI Configured
3	2016 RB Configured			1762 RB Configured		0730 RB Configured				1794 RB Configured		
4	1xb1974 EDII_site Configured			1xb6121 gliteCE Configured sl4+arch32+mm2		0743 gliteCE Configured				1926 EDII_top Configured		1919 gliteCE Configured
5	2018 CE Configured			2034 CE Configured		2035 CE Configured		LSF		1938 CE Configured		1779 CE Configured
6	0731 MNcomb Configured			6122 MNcomb Configured sl4+arch32+mm2		0741 MNcomb Configured		6115 CE Configured		1758 MNcomb Configured		0718 MNcomb Configured
7	1921 EPM_mysql Configured			1xb6125 MNcomb Configured sl4+arch32+mm2		1716 MNcomb Configured				1916 EPM_pool Configured		0734 MNloc Configured
8				1xb6126 MNcomb Configured sl4+arch32+mm2		1720 MNcomb Configured	6127 EPM_mysql OS	gCondor	torqueTest	1751 dCache_mysql Configured		1777 dCache_mysql Configured
9				1xb1017 EPM_mysql Configured		0734 SEClassic Configured	6128 LFC_mysql OS	1xm1176 gliteCE Configured	1920 CE Configured	1915 EPM_mysql Configured		1775 SEClassic Configured
10	2019 MCN Configured					1xb2036 EPM_mysql Configured	6129 FES OS	0738 MNcomb Configured	0739 MNcomb Configured			
11	1941 LFC_mysql Configured	1xb1909 FES Configured	1xb1543 MySQL Configured sl4+arch32+mm2	1782 LFC_oracle Configured	2011 FES Configured			1xb184 re0297 MNcomb OS				0727 EPM_pool Configured

- Pre-production service is now ~ 27 sites in 16 countries
- Provides access to some 3000 CPU
 - Some sites allow access to their full production batch systems for scale tests
- Sites install and test different configurations and sets of services
- Services may be initially demonstrated in this environment
 - Before further development
- New VO-s: adapt their applications & gain experience
 - (e.g. DILIGENT)



- **Operations Coordination Centre**
 - Management, oversight, coordination

- **Regional operations Centres**
 - Core support infrastructure
- **Grid User Support (GGUS)**
 - Coordination, management of user support

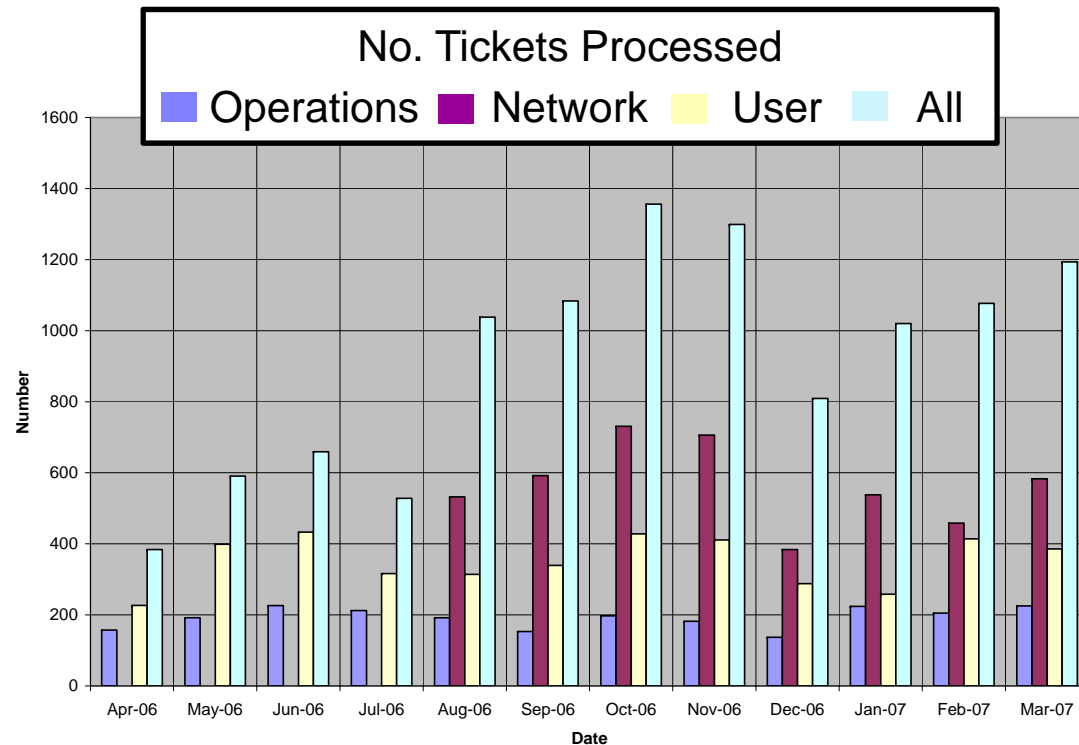


- **EGEE Network Operations Centre (ENOC)**
 - Coordination with NRENs & GEANT2

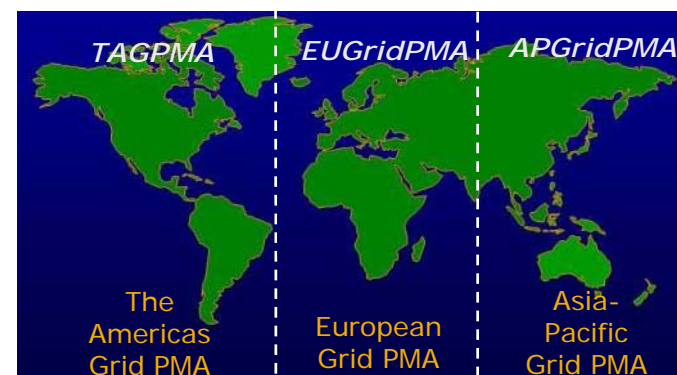
- **Fully distributed – key are the Regional Operations Centres**
 - Many of the ROCs are themselves distributed organizations
 - Grid Operator on Duty
 - Weekly rotation of teams
 - Critical activity in maintaining usability and stability of sites
 - Important tools
 - *Site Availability Monitoring and Testing(SAM)*
 - *Information system monitoring*
 - *GGUS system for trouble ticket management*
 - Portal for operations : <https://cic.gridops.org>
- **Significant work on operations procedures**
 - Evolved throughout EGEE and EGEE-II
 - Contribute to establishment of regional grid infrastructures through related projects – well beyond Europe now

- **GGUS – now well established**
 - Use continues to grow
 - Most ROCs provide dedicated effort to manage the process – similar to operator on duty teams
 - Setting up user support advisory groups to steer the priorities

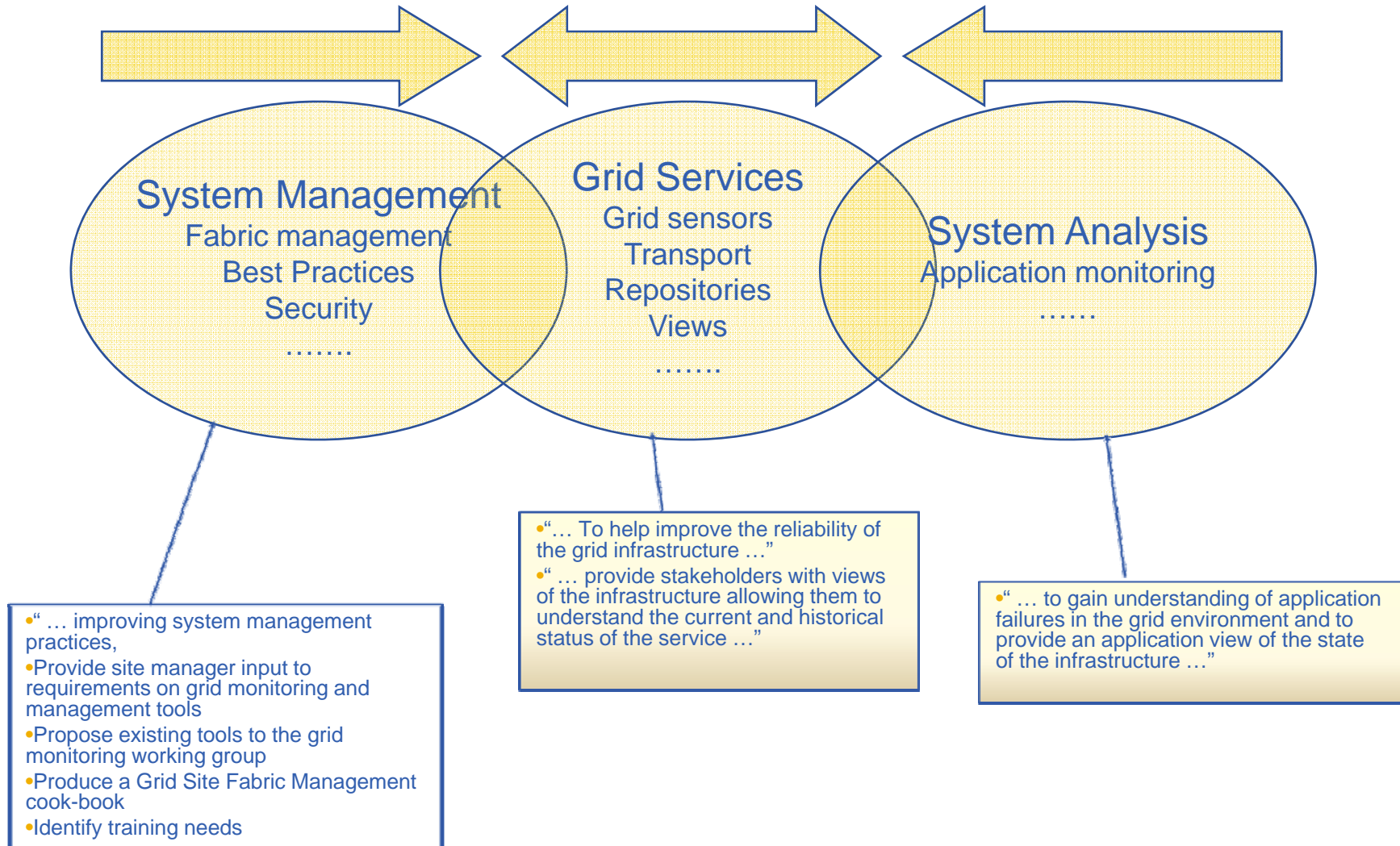
- **GGUS tool used for all support activities**
 - Interlinks many local ticketing systems



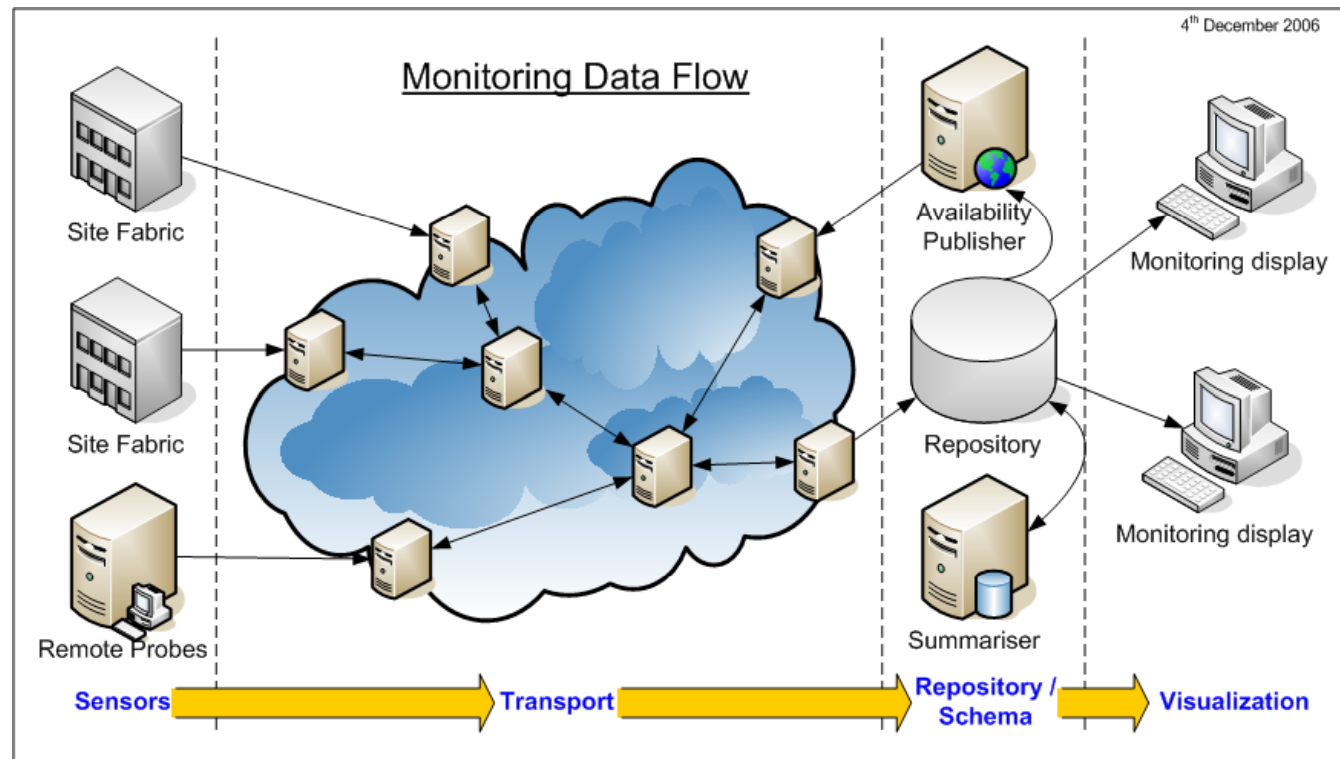
- **Joint Security Policy Group (JSPG)**
 - Produces and maintains security policy and procedures
 - for EGEE, OSG, NDGF, WLCG, and other EU Grid infrastructures
 - Achieved common policy between EGEE and OSG (for interoperation)
 - New Grid Site Operations Policy & Updated top-level Security Policy
 - Grid User AUP accepted by eIRG as good approach
 - Current work
 - New policy addressing User-level Accounting (data privacy issues)
 - New policy on VO and Grid service responsibilities
- **Operational Security Coordination Team (OSCT) focuses on:**
 - Incident Response & improvement
 - Security Monitoring
 - Best practice for system managers
 - Pan-regional security coordination
- **Grid Security Vulnerability Group**
 - New group analyzing potential vulnerabilities

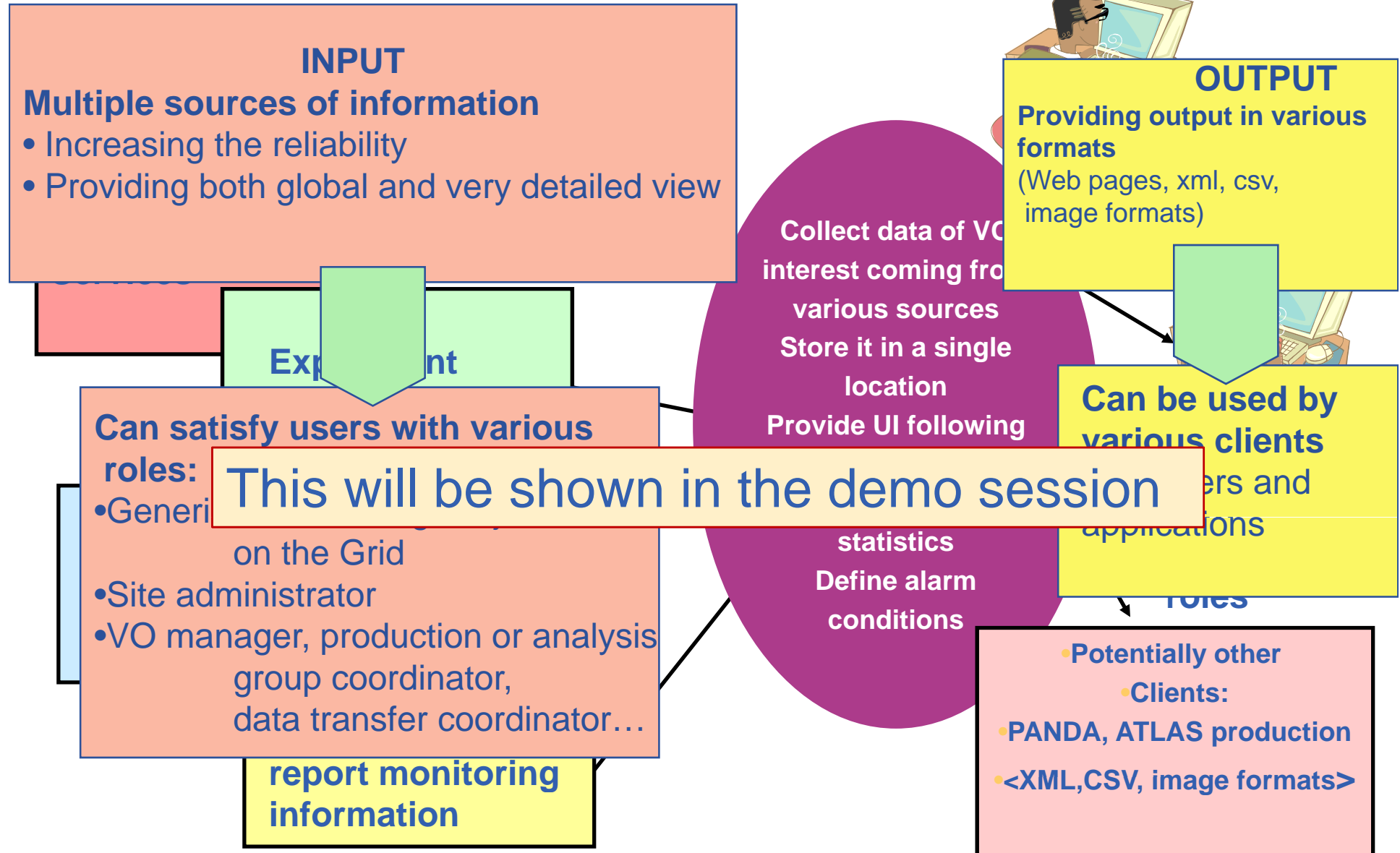


- **Becoming a critical activity to achieve reliability and stability**

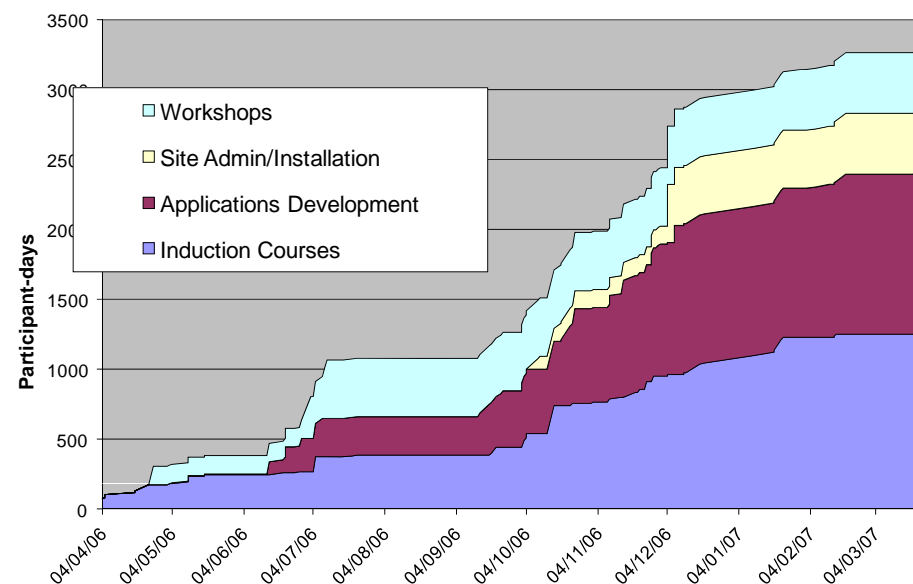


- Important to have standard solutions for:
 - Sensors
 - Repository schema
 - Interfaces

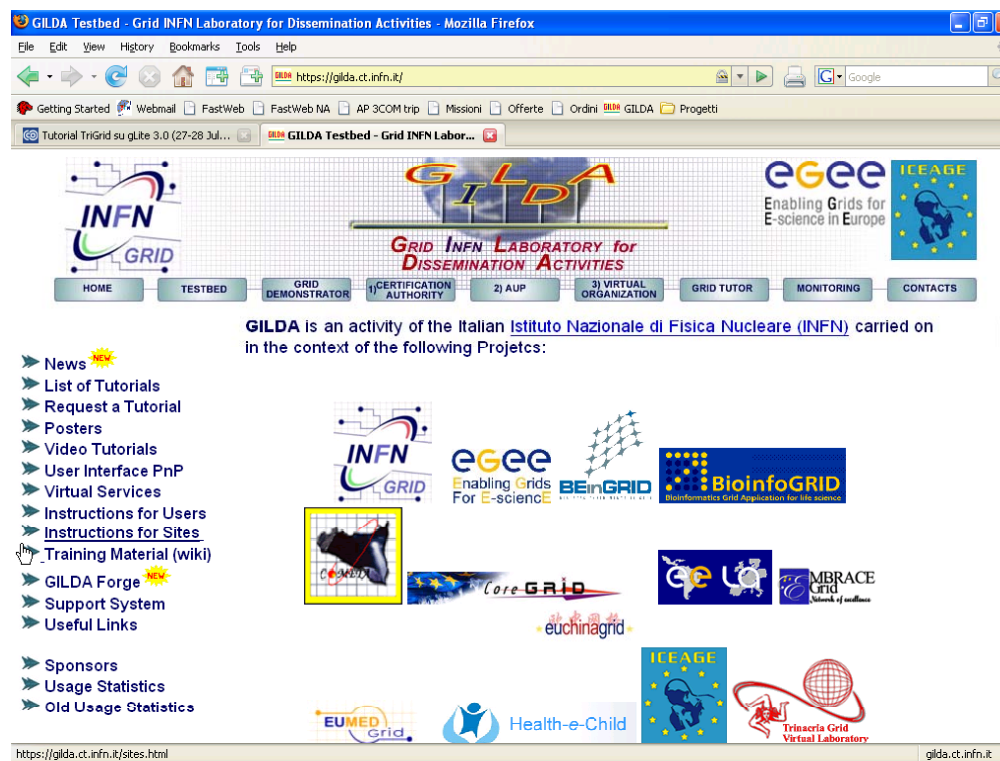




- Broad range of courses to many disciplines and clients with very different backgrounds
- Close relationships with applications and infrastructure activities for provision of material and lecturers
- Needs are expanding rapidly with new communities and 'beginner' users



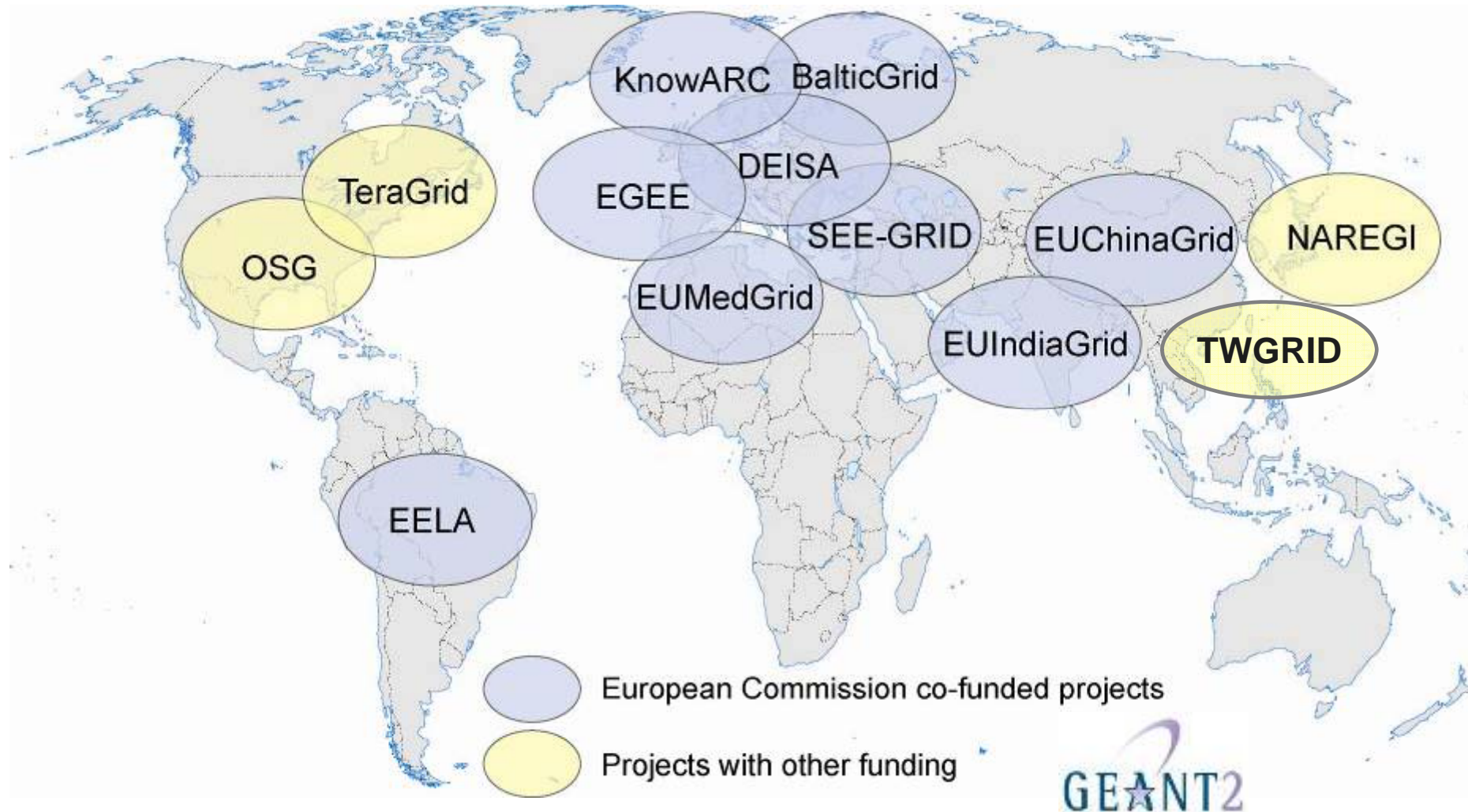
- GILDA is an effective t-Infrastructure for EGEE and other European projects, providing resources and knowledge for training events
- Besides training events, GILDA is available around the clock for grid novices, with dedicated facilities
- The GILDA t-Infrastructure is currently supported by 12 sites, managed on a best-effort basis
- GILDA is also available for application porting



- **Well established with Open Science Grid in U.S.**
 - In production use by CMS – submits work to OSG from EGEE
 - Weekly operations meetings attended by OSG staff
 - Processes set up with OSG for operations and user support workflows
 - OPS VO defined to support joint operations – for testing/monitoring use
 - Collaboration on monitoring tools and procedures
- **EGEE also working with other grid projects on specific interoperability at the level of middleware:**
 - NAREGI, Unicore, NDGF(ARC)
- **Effort in GIN in several areas key for EGEE**
- **Important to have a user community/use case driving this**

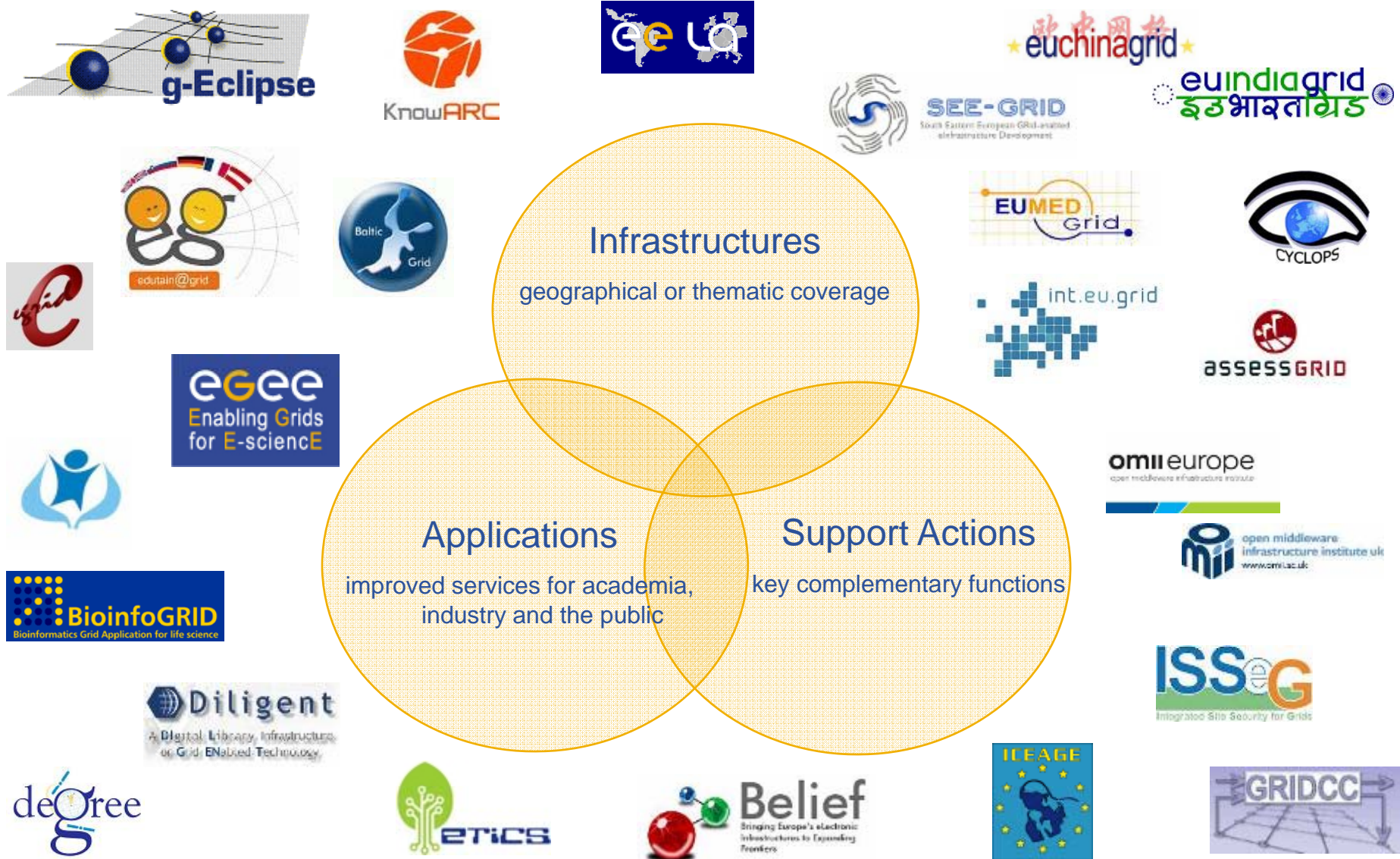
- APAC
- DEISA
- EGEE
- Naregi
- NDGF
- NGS
- OSG
- Pragma
- Teragrid





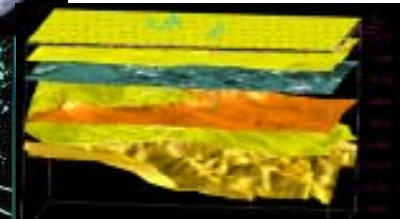
Potential for linking ~80 countries

24 projects have registered as on February 2007: [web page](#)



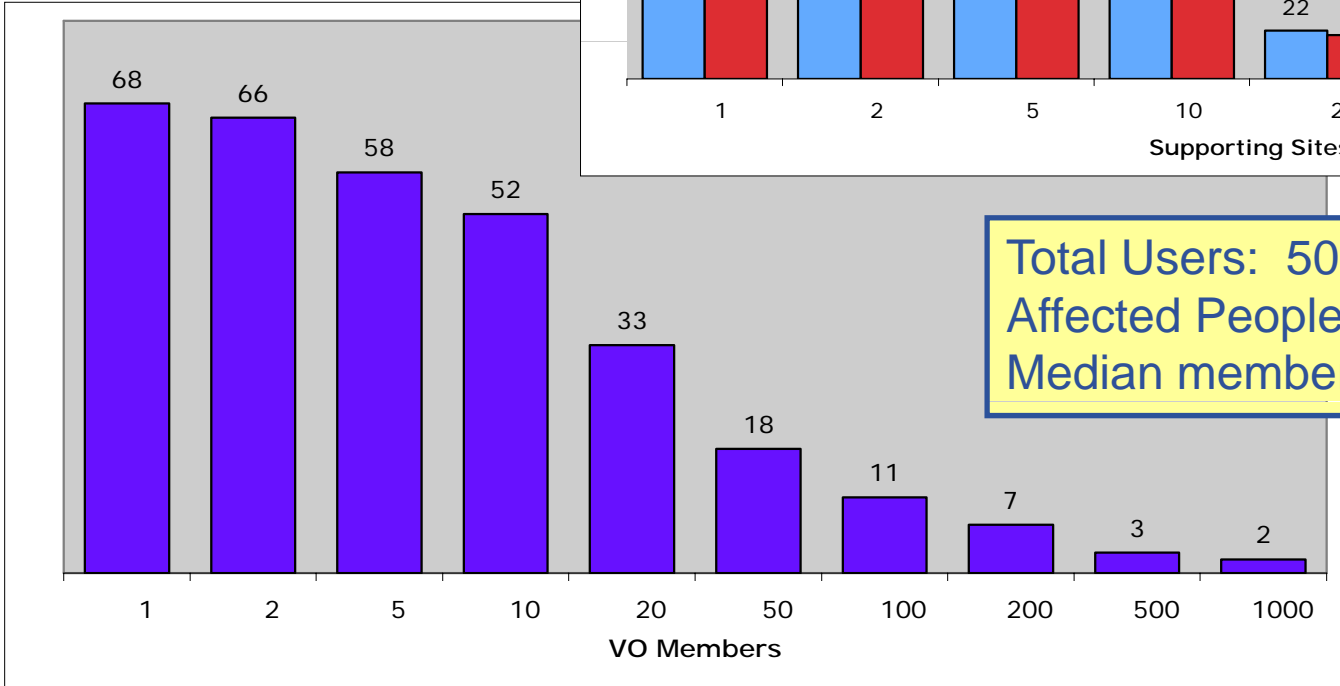
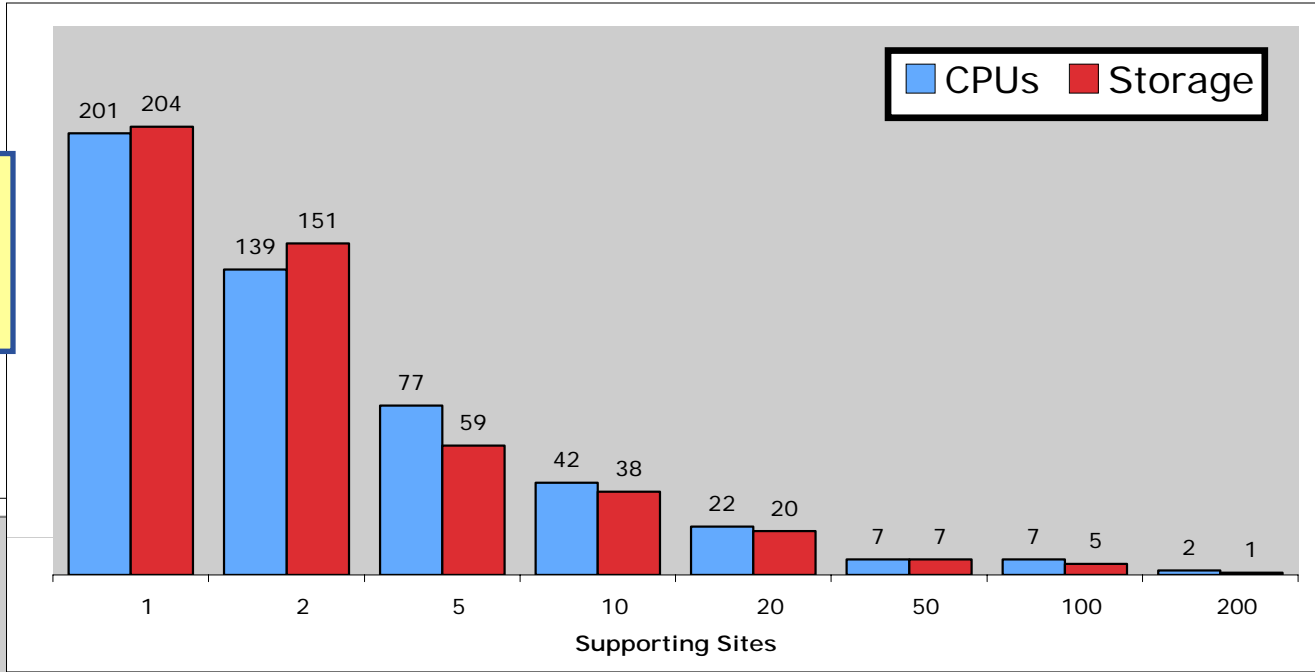
- **Multitude of applications from a growing number of domains**

- Astrophysics
- Computational Chemistry
- Earth Sciences
- Financial Simulation
- Fusion
- Geophysics
- High Energy Physics
- Life Sciences
- Multimedia
- Material Sciences
-



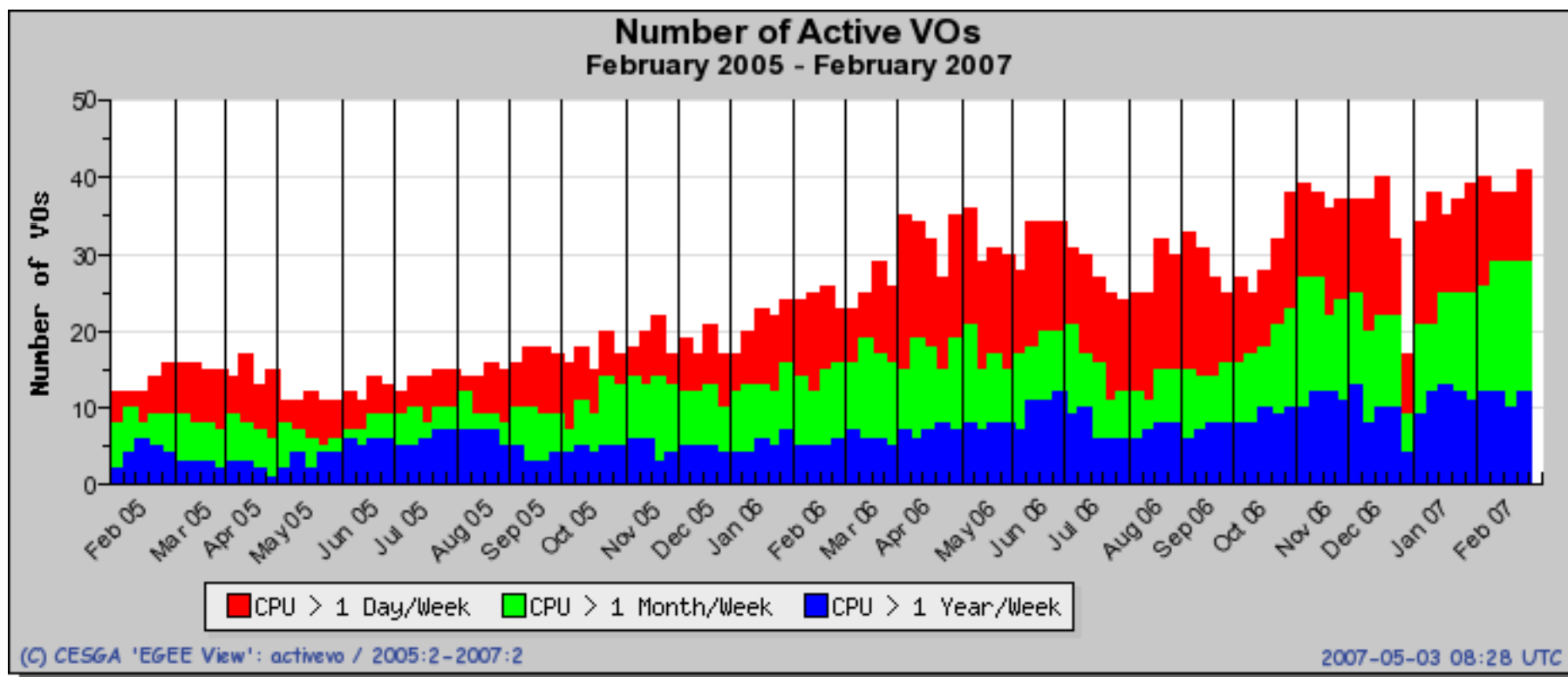
**This is an exciting year for science – LHC, the largest scientific instrument ever built, comes on-line
- Grids are key to the success of LHC analysis**

Total VOs: 204
 Registered VOs: 116
 Median sites per VO: 3

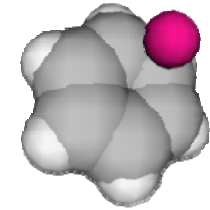
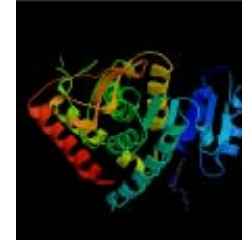


Total Users: 5034
 Affected People: 10200
 Median members per VO: 18

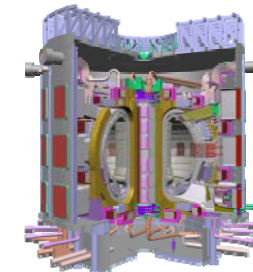
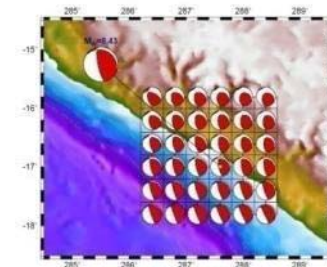
- Number of “active” VOs growing with time.
- Turnover not shown: not same VOs every week!



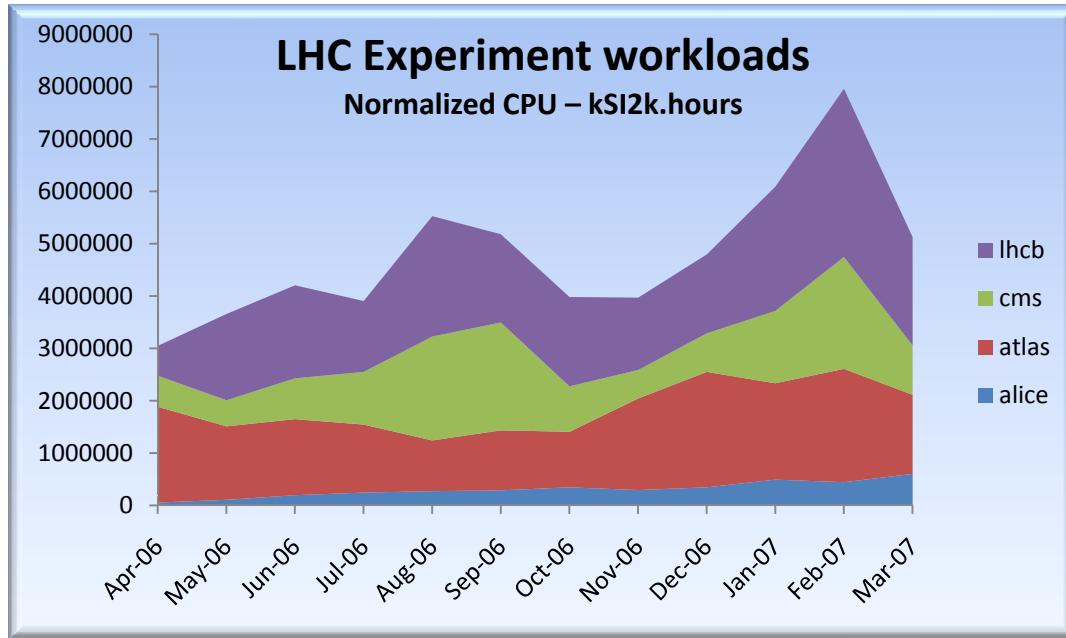
- Disciplines: 10
- Sub-disciplines: 36
- See growth and diversification of applications.
- Reported apps. only



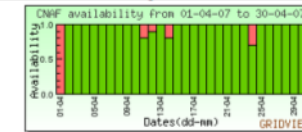
	PM3	PM11
Astronomy & Astrophysics	2	8
Computational Chemistry	6	27
Earth Science	16	16
Fusion	2	3
High-Energy Physics	9	11
Life Sciences	23	39
Others	4	14
Total	62	118



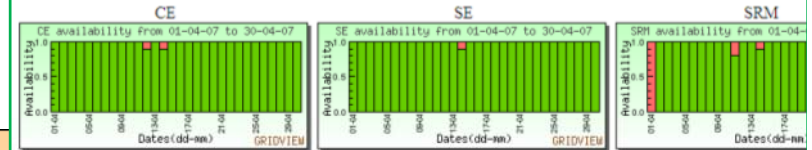
Condensed Matter Physics
 Comp. Fluid Dynamics
 Computer Science/Tools
 Civil Protection



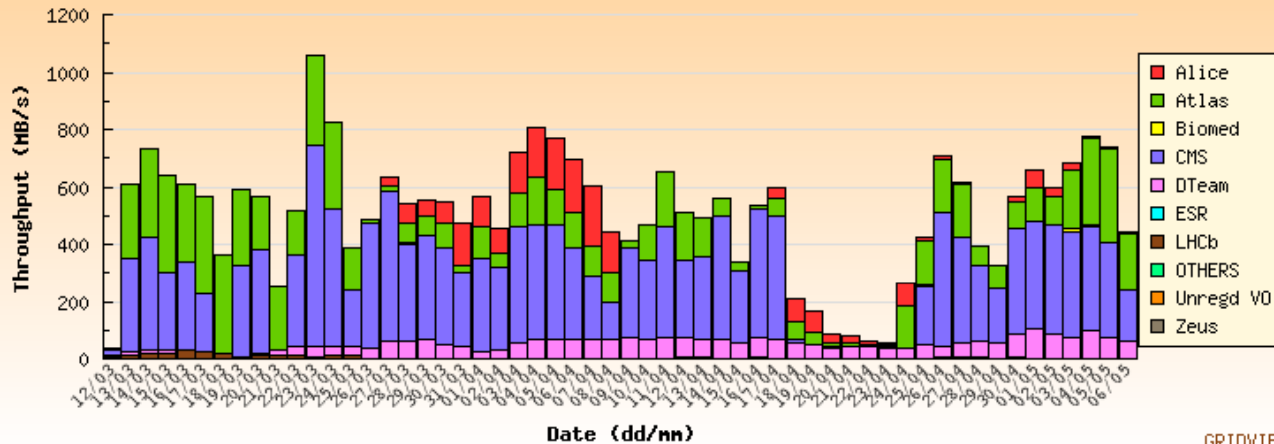
Overall Service Availability for site CNAF : Daily Report



Individual Service Availability for site CNAF : Daily Report

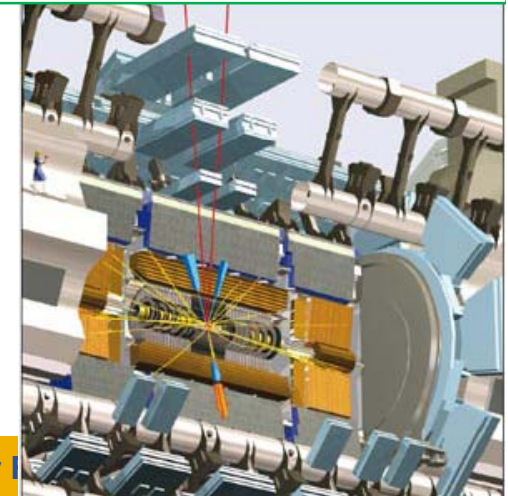


Averaged Throughput From 12/03/07 To 06/05/07
VO-wise Data Transfer From All Sites To All Sites



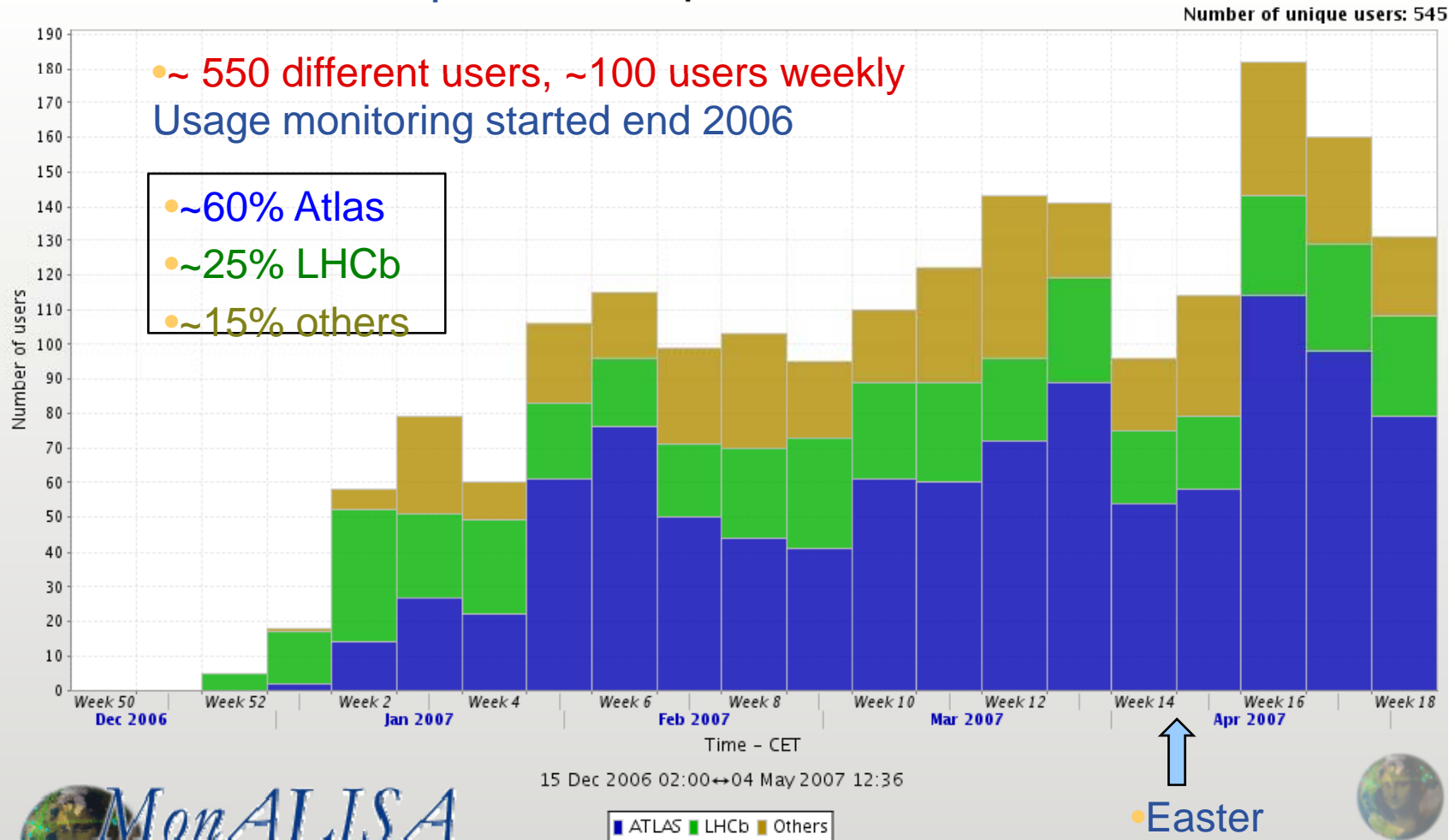
GRIDVIEW

User I



Enabling Grids for E-science

- Used ATLAS and LHCb experiments,
- developed with the contribution of EGEE NA4

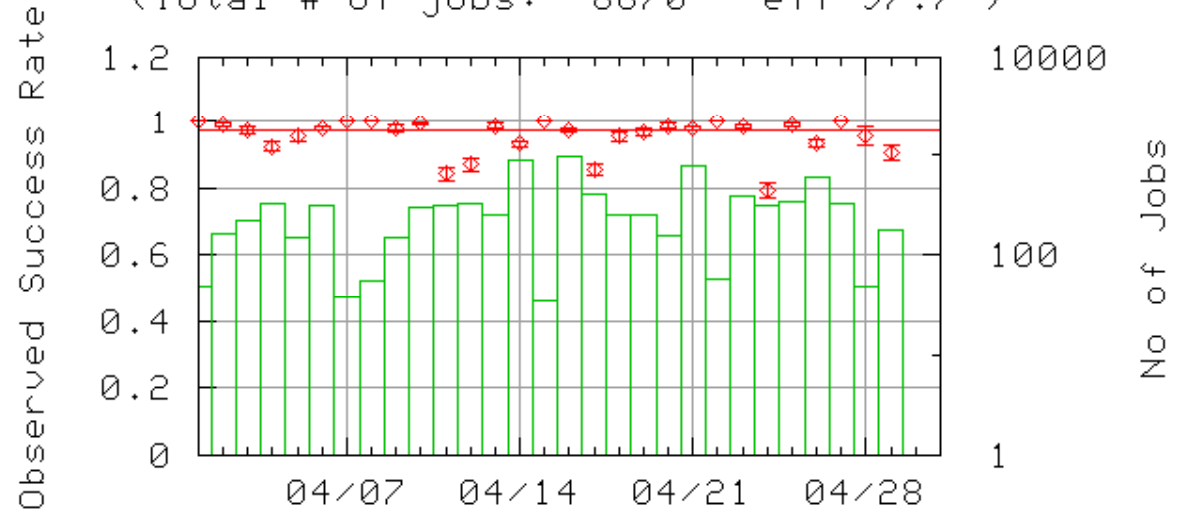


•CRAB Jobs @ FNAL (OSG)

- Users on the grid:
- April 2007 statistics -
- CMS users submitting jobs to Grids via CRAB
- (developed by CMS)

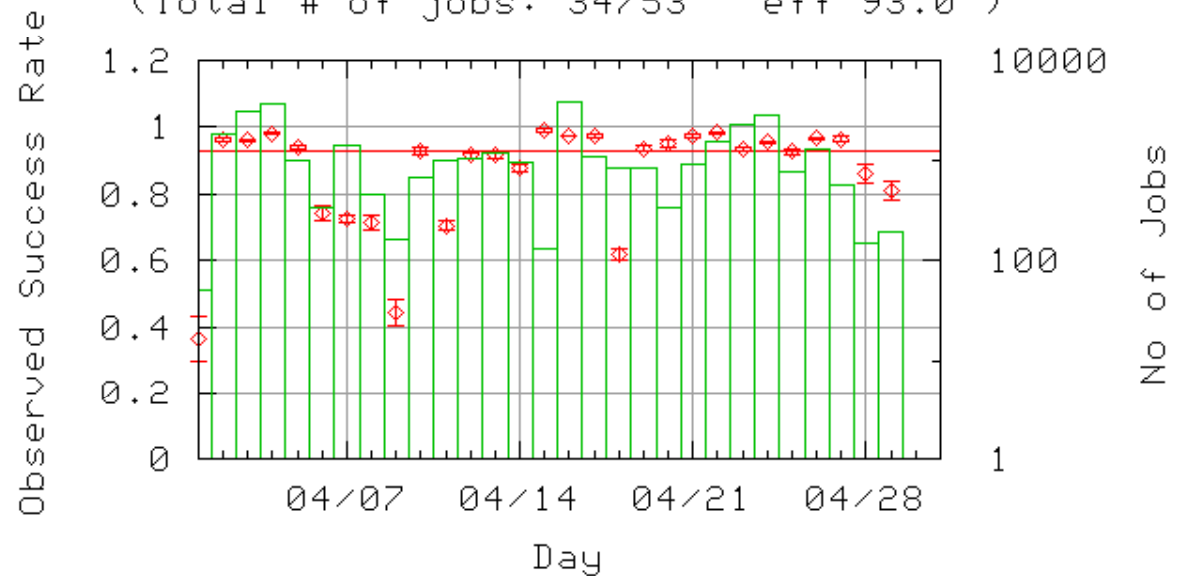
•Over 1,000 job/day
Efficiency over 90%

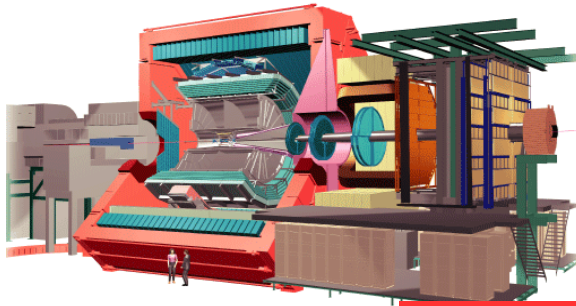
(Total # of jobs: 8670 eff 97.7)



•CRAB Jobs @ CERN (EGEE)

(Total # of jobs: 34753 eff 93.0)

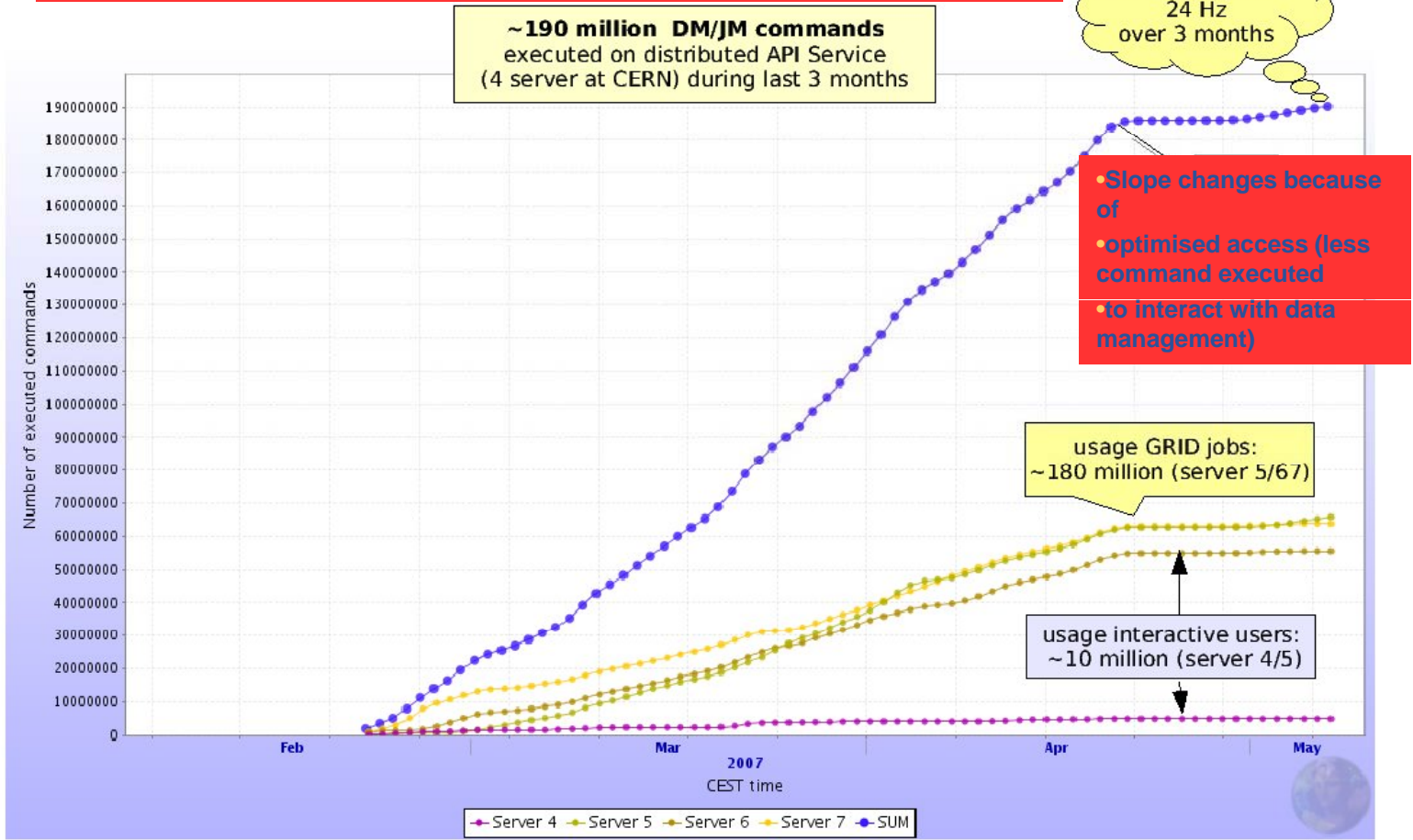




ing Grids for E-science

ALICE Grid Access Service

• ALICE Grid Access (commands executed)

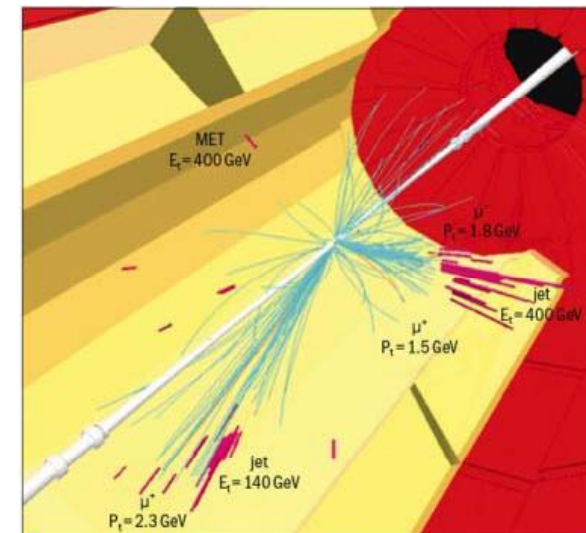


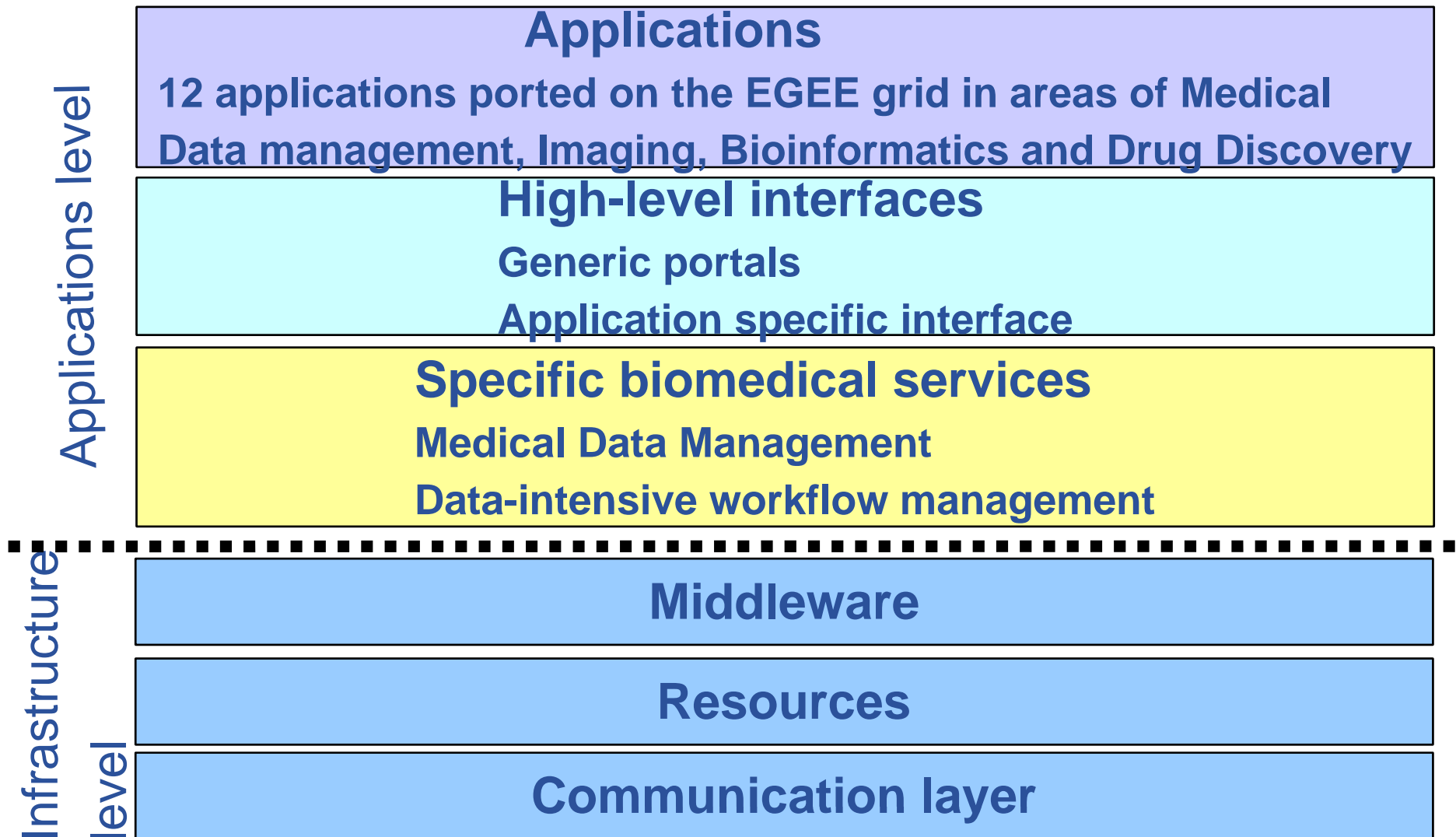
- **Data management:**
 - Demonstrated data transfers at nominal rates: 1.6 GB/s through FTS
 - 1 GB/s with real (simulated) workloads
 - 2 large experiments transferred >1 PB/month in summer 2006

- **Workload management**
 - CMS – computing service challenge achieved 50k jobs/day
 - CMS aim this year for 100k jobs/day; ATLAS for 60k

- **Reliability and availability**
 - Significant effort to ensure Tier 1 sites meet MoU commitments – using site and service monitoring

- **Grid is now the primary source of computing resources for LCG**





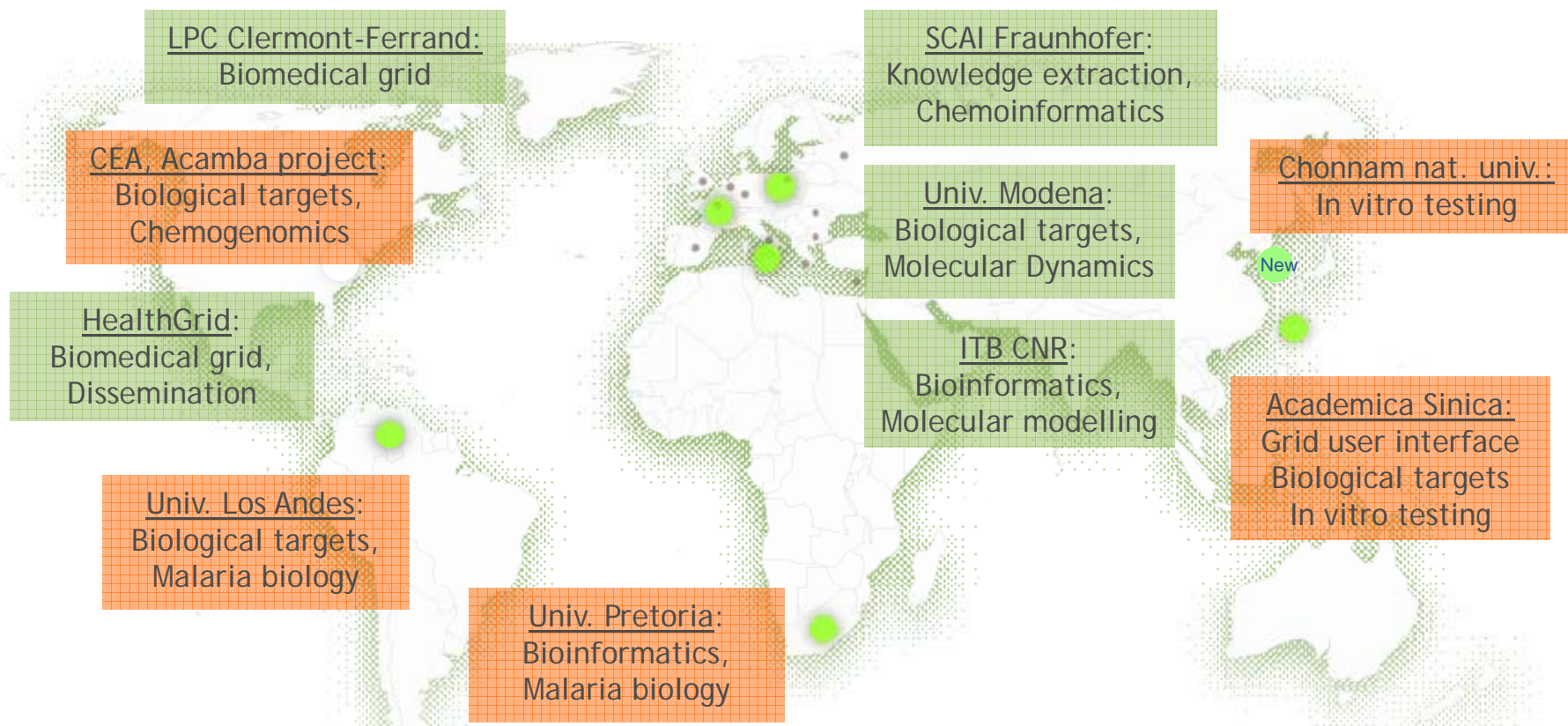
- **WISDOM** (<http://wisdom.healthgrid.org/>)
 - Developing new drugs for neglected and emerging diseases with a particular focus on malaria.
 - Reduced R&D costs for neglected diseases
 - Accelerated R&D for emerging diseases

- **Three large calculations:**
 - WISDOM-I (Summer 2005)
 - Avian Flu (Spring 2006)
 - WISDOM-II (Autumn 2006)

- **WISDOM calculations used FlexX from BioSolveIT in addition to Autodock.**



	Targets	Com- pounds	CPU- years	Duration (wk)	Max. CPUs	Size of Results (TB)
WISDOM-I (Q3'05)	PBD	1M	80	6	1700	1
Avian Flu (Q2'06)	H5N1	300k	105	6	1700	0.750
WISDOM-II (Q4'06)	GST DHFR DHFR Tubulin	125M	420	8	5000	2

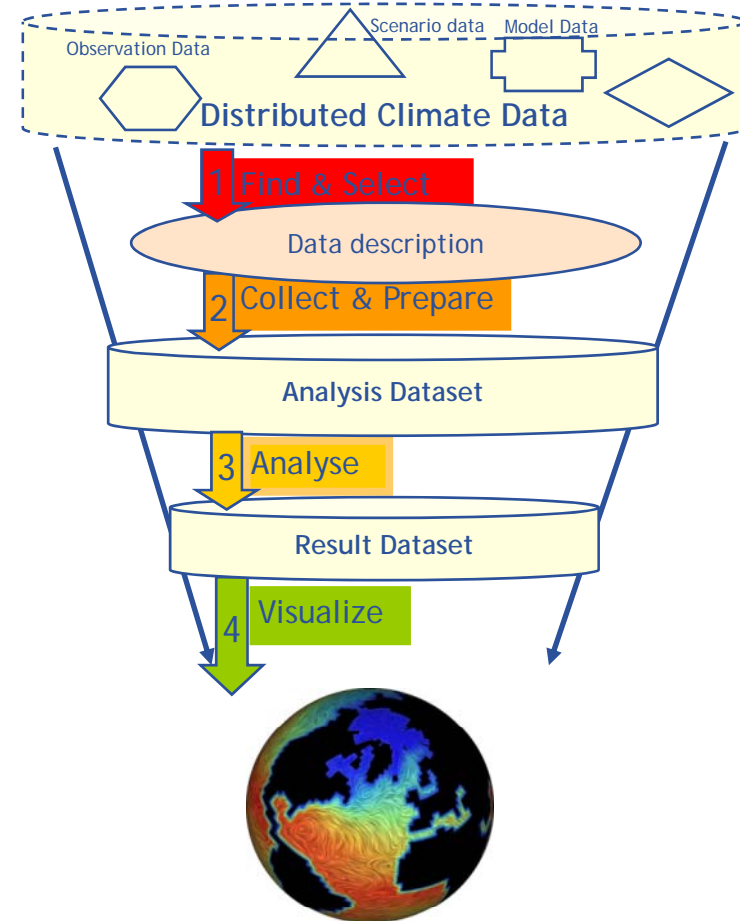


Avian flu data challenge: in the selection of 2250 compounds out of initial 308585 compounds, an enrichment factor of 111 was observed. Experimental trial confirms 7 actives out of 123 tested gave "potential hits".

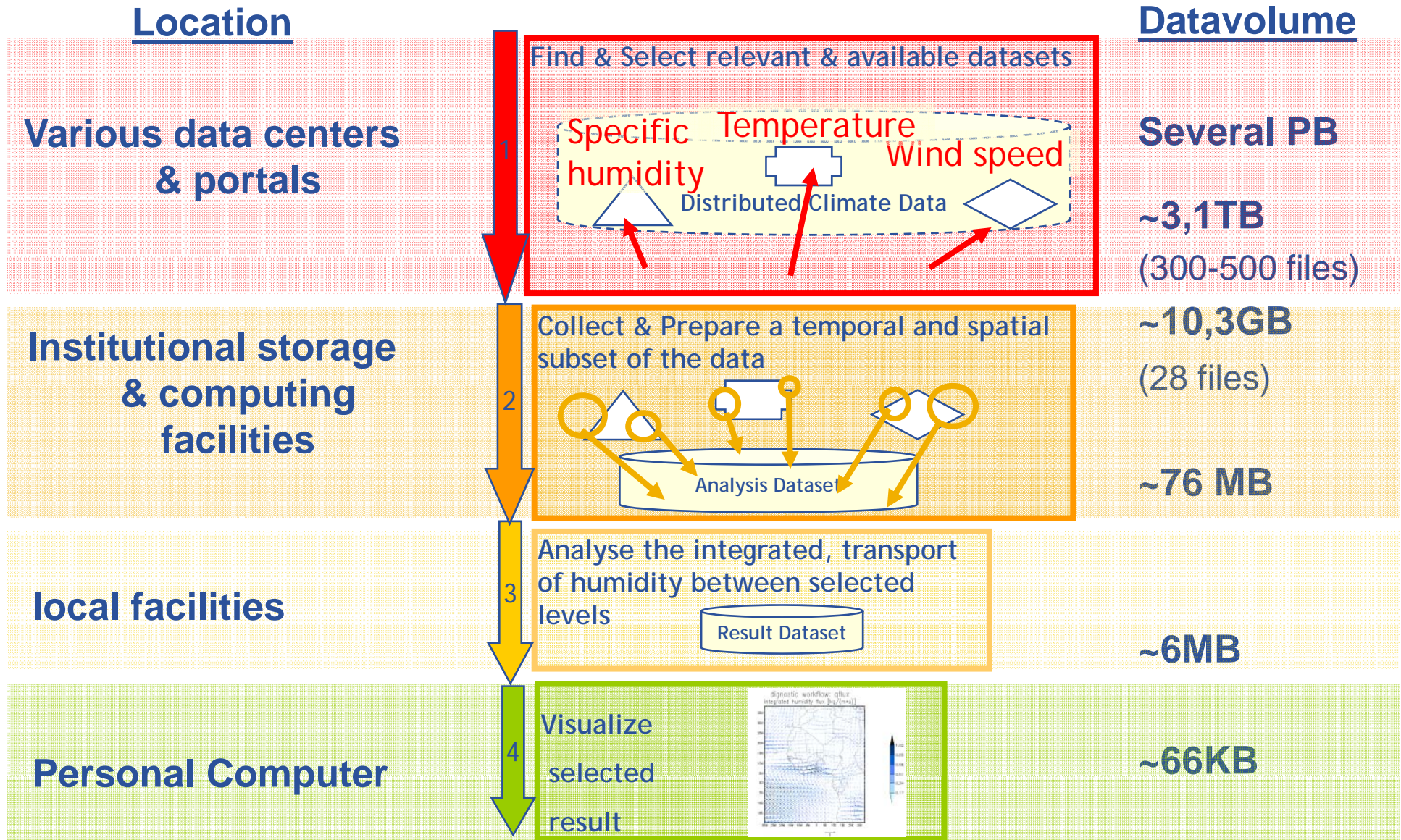
Data challenges on malaria: the 25 most promising compounds out of 500.000 are now being tested in vitro at Chonnam National University

- **Goal:** learn about the past, the present, and possible futures of the earth system
- **Community:** internationally and interdisciplinary distributed but strongly interconnected
- **Method:** Analysing, comparing and processing data
- **Input:** data from observations and/or other modelling studies

Typical workflow



An example workflow: "qflux"



Current issues

- **Search & select**
 - Different portals with **different authentications and data descriptions**
- **Collect & prepare**
 - **Different access mechanisms** of the different providers
 - Pre-processing requires **sufficient local facilities**
- **Analyse**
 - Existing **tools** and already processed **data** are **available locally** and **miss proper description**
- **Visualize**
 - **Detached** from the remaining workflow

• **Central unique authentication** to a common catalogue with **standardized metadata**

• **Shared resources** with **standardized access** hiding proprietary access mechanisms

• Commonly defined **tool description**
 • **Log** processing steps and **automatically republish** processed data

• Integrate basic visualization (**first peep**) into the workflow

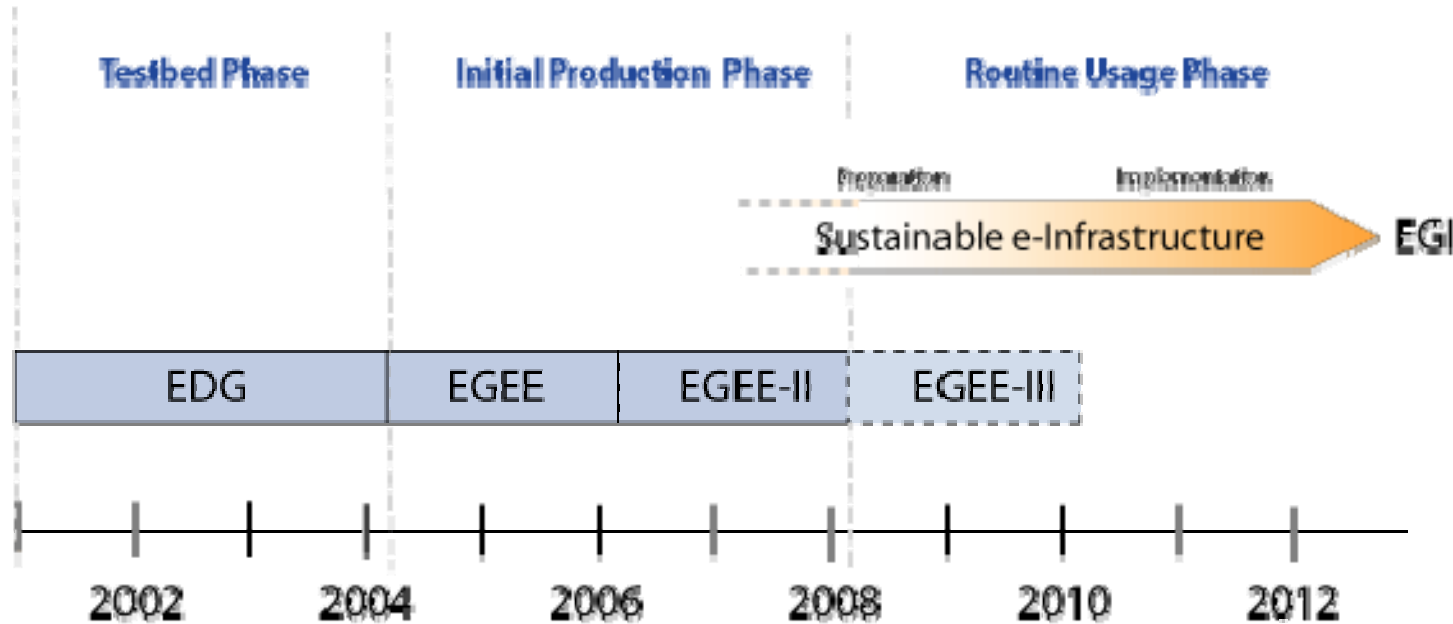
- **Specific applications**

- Atmosphere and Ocean Models
- Earthquake modelling
- Fusion
- Range of biomedical applications
- Computational Chemistry
- Astrophysics
- Space applications
- HEP (LHC and non-LHC)

- **Applications in Related Projects**

- EUMEDgrid
- BalticGrid
- EELA
- EUChinaGrid
- EUIndiaGrid
- G-Eclipse
- SymGrid
- DILIGENT
- BelnGrid

- Need to prepare permanent, common **Grid infrastructure**
- Ensure the long-term sustainability of the European e-infrastructure independent of short project funding cycles
- Coordinate the integration and interaction between National Grid Infrastructures (NGIs)
- Operate the European level of the production Grid infrastructure for a wide range of scientific disciplines to link NGIs



- **EGEE and other grid infrastructures need to co-exist and interoperate**
 - At many levels – campus, local, national, regional, international
- **A large production system has inertia – cannot change quickly**
 - Introducing new software and standards is slow, need to maintain backward compatibility
 - Cannot frequently change the infrastructure
- **gLite choice of standard adoption is based on interoperability needs and impact assessment on the infrastructure**
- **Operational experience essential**
 - Leads to **best practices** which in turn should drive standardization efforts
 - Actively pushing convergence for most pressing needs
- **The EGI/NGI era will rely on interoperability and coexistence**
 - **Appropriate and workable** standards will be essential
 - Care not to fix standards too soon – this is not mature technology

See also: <http://egee-na5.web.cern.ch/egee-na5/NA5Standardisation.html>

EGEE has worked on real community implementations of standards

- **Example 1: SRM (Storage Resource Manager)**

- SRM v2.2 defined > 1 year ago to satisfy LCG requirements
- Dedicated effort to reach today with beta versions of real interoperating implementations (5) – and this was vital for LCG
 - Needed many iterations on details of the specifications
 - Interoperation test suites and real use case testing was essential
- Also required changes to all clients – the APIs were completely changed from SRM v1.1

- **Example 2: GLUE (information system schema)**

- Today this is the accumulated knowledge of experience in real large scale production of EGEE, OSG, ARC over 5 years
- The information systems are not perfect – we see scalability problems
- The experience is in the schema
- It can and should evolve to something better – but it must **evolve**
- Is an OGF working group

Driven by the need for interoperation, co-existence, etc.

EGEE is actively involved in many areas, including with OGF

- **Security (AAA)**
 - Policy work & IETF wg on Incident Response
 - VOMS and proxy certificates
 - Interoperability with Shibboleth
- **Data Management**
 - SRM, FTS
- **Accounting & monitoring**
 - Common usage record, schema, sensors
- **Job Management**
 - Gatekeeper interfaces
- **Information system**
 - Common schema

- **Important for coexistence/interoperability:**
 - areas close to fabric (accounting, monitoring, sensors, etc.) need to be *common*

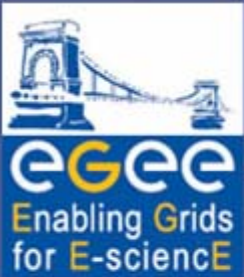
General issues:

- **Making grid tools easily usable by non-experts**
- **Failures not easy to understand**
 - Lack of consistent or thorough error reporting
- **Lack of consistent administrative interfaces makes them hard to manage**

EGEE issues:

- **Portability of current gLite distribution prevents wider acceptance and coexistence**

- **EGEE is operating the world's largest multi-disciplinary grid for science**
 - In continuous use for production work at significant scale
- **Can bring experience at operating at this scale to the community and the standardization process**
 - But we have to prioritize carefully
- **There is a long way to go to improve:**
 - Usability, manageability, reliability, security
 - Interoperability and coexistence
- **It is time to move towards ensuring the long term sustainability of these infrastructures**
 - Will rely on carefully selected common solutions for key services and processes



1-5 October, 2007
Europe Congress Center (ECC)
Budapest, Hungary

Building Bridges...

- Between Science and business
- Between users and infrastructures
- Between countries
- Between scientific disciplines
- Between projects

<http://www.eu-egee.org/egee07>

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Wednesday

Opening Plenary			
Astro Workshop	Grids Mean Business	gLite	
		GIN	
		OMII-Europe	
Poster and Demonstrations			

Thursday

Data Management	Experience with Application Domains	Users in the wider grid community	Workflow
Poster and Demonstrations			

Friday

Data Management	Experience with Application Domains	Users in wider grid community	Workflow
Grid Monitoring & Accounting		Interactivity & portals	User/VO community support
Closing Plenary			